DECEMBER, 1933.

GENERAL PHYSICS.

ADSORPTION.

5095. Analysis of Hydrogen Adsorption Phenomena. M. C. Johnson. *Faraday Soc., Trans.* 29. *pp.* 1139–1155, *Sept.*, 1933.—Discussion of adsorption of hydrogen in the light of the greater ease of evaporation of H_2 as compared with H_1. Where the partial pressure of H_1 is small in the gas, equilibrium may be reached more rapidly by dissociation of H_2 in the adsorbed layer. Metals and non-metals behave differently. A. S. C. L.

5096. Decrease of the Interfacial Energy and Increase of the Dispersibility of Solids on the Formation of an Adsorption Layer. P. Rehbinder and N. Kalinowskaja. *Phys. Zeits. d. Sowjetunion,* 4. 2. *pp.* 365–396, 1933.—It is shown that since hardness is measured in terms of the work required for dispersion of the surface, it may be diminished considerably by adsorption of capillary active substances. This effect, which is of significance in many technical processes, has been studied, at various concentrations of adsorbed substance, for the processes of grinding, polishing, boring, filing, sawing, etc.; parallel results are obtained in each case. The hardness decrease—concentration curves (" dispersibility isotherms ") are very similar to the adsorption isotherms; the limiting decrease is attained when the adsorption layer is saturated. For active substances of the same homologous series the dispersibility follows the Traube rule, *i.e.*, the sclerometric hardness increases 3–3·5-fold when the chain is lengthened by a CH_2 group. For adsorption of marble from organic solvents, however, the rule is not valid, probably because of the high porosity of the marble. The plastic deformation which occurs when a metal surface is ruptured obscures the effect of hardness decrease. In grinding in, *e.g.*, ball mills, the adsorption effect is of importance only at certain values of the solid:liquid ratio. H. F. G.

5097. Activated Adsorption of Gases by Carbon. R. Burstein, P. Lewin and S. Petrow. *Phys. Zeits. d. Sowjetunion,* 4. 2. *pp.* 197–211, 1933.—The adsorption of various gases by pure carbon and carbon containing 0·2 % of platinum is investigated at different temperatures. With hydrogen between −183 and +100° C. the platinum has no appreciable effect upon the rate of adsorption, while the difference in the amount of gas adsorbed is explicable as due to adsorption by the platinum. Between 300 and 800° C. the amount of hydrogen taken up increases with temperature. At 300° C. the rate of adsorption is greater for the carbon containing platinum, but at 800° C. this difference disappears. At 300° C. the amount adsorbed at first increases proportionally to the square root of the time, while measurements after equal times show proportionality to the square root of the final pressure. The hydrogen absorbed at 300° C. cannot be removed at the same temperature. In the case of carbon monoxide the adsorption is greater for the carbon containing the platinum. The amount taken up decreases as the temperature is raised between 400 and 800° C. In the initial stages the amount adsorbed increases proportionally to the square root of the time. The presence of the platinum exerts a slight catalytic influence on the adsorption of ethylene and ethane, but with nitrogen no effect is observed. L. A. W.

5098. Surface Oxides of Charcoal and Adsorption of Electrolytes. L. Lepin. *Phys. Zeits. d. Sowjetunion,* **4. 2.** *pp.* **282–294, 1933.**—The problem is considered as to the manner in which gas, which has been in contact with adsorbents (active charcoal), can promote the adsorption of electrolytes, and the Schilow theory of surface compounds is discussed in this connection. It is found that the adsorption of electrolytes is only influenced by those gases which can chemically combine with the adsorbent. Ionic adsorption is therefore to be regarded as a superficial ionic reaction. H. H. Ho.

5099. Ionic Adsorption at Metals and Charcoal. A. Frumkin. *Phys. Zeits. d. Sowjetunion,* **4. 2.** *pp.* **239–261, 1933.**—This comprehensive paper deals with the subject under the following headings: Direct observation of the adsorption process which takes place by contact of a solution with a large metallic surface; measurement of the amount of electricity which must be applied at an electrode in order to keep the potential constant during enlargement of the surface; direct measurement of the electrode potential under conditions which render impossible the formation of a double layer; dependence of the boundary surface tension (metal/solution) on the potential; electrokinetic measurements. The paper concludes with a discussion of the hydrogen electrode. H. H. Ho.

5100. Properties of the Double Layer and the Exchange Adsorption of Ions at Non-Metallic Surfaces. B. P. Nikolski. *Phys. Zeits. d. Sowjetunion,* **4. 2.** *pp.* **266–281, 1933.**—Problems concerning the structure and properties of the ionic double layer at the boundary between solid phase and solution are first discussed in connection with ionic exchange adsorption. Following, comes an investigation of the magnitude of the surface charge and of the average distance between the neighbouring charges. The phenomena of exchange adsorption are found to lead to conclusions concerning the magnitudes of the primary particles of the adsorbents and of the adsorbing surface; as examples of such calculations, the cases of freshly precipitated aluminium hydroxide and kaolin are given in detail. The final section discusses the quantitative investigation of the exchange adsorption phenomena of ions, and an equation for the isotherms is derived. H. H. Ho.

5101. Adsorption of Electrolytes and ζ-Potential. A. J. Rabinowitsch. *Phys. Zeits. d. Sowjetunion,* **4. 2.** *pp.* **304–321, 1933.**—The phenomena of adsorption and ζ-potential are studied by means of measurements of cataphoretic velocity. The bearing of the results is discussed and coordinated with the conclusions of other observers. F. J. B.

See also Abstracts **5112, 5180, 5183, 5410, 5431, 5484, 5489.**

ATOMIC AND MOLECULAR STRUCTURE.

5102. Isotopes of Noble Gases and Hydrogen. P. Zeeman and J. de Gier. *K. Akad. Amsterdam, Proc.* **36. 6.** *pp.* **609–611, 1933.**—Using a modified Thomson-Conrad mass spectrograph [see Abstract **1047** (1931)], He, Ne, and A showed weak parabolæ probably due to hydrides of the inert gases. A mixture of hydrogen isotopes showed indications of $(H_2^2\,H^2)^+$ and $(H^1\,H_2^2)^+$ ions. Great current intensity, demanding high pressure, favoured the production of different triatomic ions, but was offset by the resulting smaller free path length. [See following Abstract.]

N. M. B.

5103. Isotope of Hydrogen. P. Zeeman and J. de Gier. *K. Akad. Amsterdam, Proc.* 36. 7. *pp.* 716–717, 1933.—A continuation of previous work [see preceding Abstract] with hydrogen containing 10 % $H^1 H^2$ gave parabolæ ascribed to the $(H_3^2)^+$ and $(OH_2^1 H^2)^+$ ions, the latter arising from water vapour, which can never be entirely eliminated, in the discharge tube. N. M. B.

5104. Physical System of the Elements. C. G. Bedreag. *Comptes Rendus,* 197. *pp.* 838–840, *Oct.* 16, 1933.—The arrangement of the elements previously deduced [see Abstracts 291 and 1548 (1925)] has been confirmed by subsequent investigations ; revised tables are given showing but slight modification. C. A. S.

5105. Theory of Multiple Bonds. A. Burawoy. *Zeits. f. phys. Chem.* 166. *Abt.A.* 5–6. *pp.* 393–400, *Oct.*, 1933.—It is concluded from optical data, that organic compounds with multiple bonds occur in different electroisomeric states, *e.g.*, as bi-radicals or as molecules with developed conjugated systems, or as completely saturated compounds corresponding to the usual structural formulæ. By these conceptions all the properties of such compounds may be explained. To bi-radicals and molecules with developed conjugated systems are attributed not only the (R- and K-) bands which occur in the spectral region of 200 to 800 $m\mu$, but likewise also the great reactivity of compounds with multiple bonds. From the concentration of bi-radical molecules in this equilibrium of electroisomeric molecules, it is calculated, by means of the exponential law $C=E^{-q/RT}$, that the energy difference between bi-radical molecules and saturated molecules, *i.e.*, the splitting energy of the second or third bond of the multivalent linkage varies for different compounds between 2·5 and 9·0 k.cal. This small energy of revolution explains the great reactivity of unsaturated anions which hitherto appeared to contradict the conception of multiple bonds. H. H. Ho.

5106. Electron Diffraction and Molecular Structure: Carbonyl Compounds. R. W. Dornte. *Am. Chem. Soc., J.* 55. *pp.* 4126–4130, *Oct.*, 1933.—The molecular structure of carbonyl sulphide, chloride, and bromide, acetyl chloride and bromide were investigated by electron diffraction. The results were in agreement with other structural determinations. Carbonyl sulphide was found to have a linear structure. The other molecules were represented by plane " Y " models. The angle between the halogen atoms of carbonyl chloride and bromide was found to be 110°. F. J. B.

5107. Quantum-Mechanical Stability of Benzene Molecule. M. Markov. *J. Chem. Phys.* 1. *pp.* 784–788, *Nov.*, 1933.—The Heitler-London-Rumer treatment of valence bonds is applied to the benzene molecules, considered as a system of six trivalent nitrogen-like CH-groups. Partial solution of the secular equation of the thirty-fourth degree shows that this model of the benzene ring, though stable mechanically, is thermodynamically unstable. H. H. Ho.

5108. Fluidity Method for Determination of Association. E. C. Bingham and L. W. Spooner. *Physics*, 4. *pp.* 387–400, *Nov.*, 1933.—The paper contains fluidity data for about 346 liquids to be used for reference. They are arranged as fluidities at particular temperatures. Temperatures at particular fluidities were also obtained and from the latter tables, associations were calculated. The factors affecting association are briefly discussed which leads us to a tentative classification of associating and protecting groups. Finally, the distinction between association, polymerisation and condensation and polymerisation is discussed. AUTHORS.

See also Abstracts 5122, 5136, 5172, 5250, 5251, 5253, 5254, 5255, 5256, 5257, 5258, 5259, 5293, 5333, 5334, 5342, 5379, 5441, 5442.

COLLOIDS.

5109. Capillary-Electrical Investigations on Silver Halogen Compounds. H. R. Kruyt. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp.* 295–303, 1933.—The present state of theoretical colloid chemistry is discussed. An exhaustive quantitative investigation is undertaken to clear up some of the problems of colloid chemistry. The work begins on the halogen salts of silver, and the streaming potential measurements are carried out on these materials. F. J. B.

5110. Structure of the Electrical Double Layer. L. W. Janssen. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp.* 322–333, 1933.—It is considered that the present state of colloid chemistry demands a quantitative method of treatment for the double layer. The spatial potential course in the double layer is calculated for monovalent ions, and its dependence on transformation and concentration. By aid of the calculations an explanation of the hitherto obscure streaming potential curves is shown to be possible. F. J. B.

5111. Electrophoresis of Lecithin in the Presence of Neutral Salt. C. W. Price and W. C. M. Lewis. *Faraday Soc., Trans.* 29. *pp.* 1181–1188, *Nov.*, 1933.—The electrophoretic mobility of lecithin, extracted from fresh egg yolks, was determined in the presence of a number of neutral salts. The results obtained with $BaCl_2$ showed that the dispersion could be regarded as a dispersion of simple amphoteric body, free from its adsorption charge. The isoelectric point of lecithin under the conditions of the determinations agreed with the value calculated by Price and Lewis. Attempts were made to separate the net charge on a lecithin dispersion, in the presence of $0{\cdot}01N$ citrate, into two parts, one due to ionisation of the amphoteric groups, and one to the adsorption of negative ions at the fatty surfaces of the particles. F. J. B.

5112. Cataphoretic Mobility of Adsorbed Proteins. A. Dummett and P. Bowden. *Roy. Soc., Proc.* 142. *pp.* 382–401, *Nov.* 1, 1933.—Measurements have been made of the electrokinetic properties, in aqueous solution, of proteins adsorbed on to different surfaces. In gelatin, the cataphoretic mobility was independent of the nature of the underlying surface, which is in agreement with the results of other workers. Experiments made on the rate of adsorption showed that surface equilibrium of the protein was reached in a few seconds in strong solutions (10^{-1} gm./litre), but took several hours in dilute solutions. Oxy- and carboxyhæmoglobin showed a sharp adsorption maximum (indicating that the surface was saturated), but the cataphoretic mobility and apparent isoelectric point depended to a marked degree on the nature of the underlying surface. The reason for this is discussed. Both the oxy- and the carboxy-hæmoglobin had identical electrokinetic properties when adsorbed, and no evidence was found for two forms of hæmoglobin possessing different isoelectric points. AUTHORS.

5113. Swelling of Silica Gel. D. G. R. Bonnell. *Faraday Soc., Trans.* 29. *pp.* 1217–1220, *Nov.*, 1933.—The effect of storing fresh silica gel in electrolyte free water at a temperature of about 70° C. has been investigated. It has been found that under certain circumstances silica gel will imbibe large quantities of water similar to a typical elastic gel. AUTHOR.

5114. Electrolytes and the Synæresis of Silica Gels. D. G. R. Bonnell. *Faraday Soc., Trans.* 29. *pp.* 1221–1226, *Nov.*, 1933.—The effect of the presence of small quantities of electrolytes on the phenomenon of synæresis has been studied. It has been found that the main effect is an increase in the velocity of coagulation. AUTHOR.

5115. Discontinuous Diffusion in Gelatin. Suzanne Veil. *Comptes Rendus*, 197. *pp.* 756–758, *Oct.* 9, 1933.—New types of Liesegang rings. [See Abstract 1298 (1933).] A. S. C. L.

5116. Physical Problems of Leather Manufacture. C. H. Spiers. *Leather Trades' Review*, 66. *pp.* 1188–1191, *Oct.* 4, 1933.—Author deals with a few physical problems of leather manufacture and shows that there is a physics of leather manufacture. Reference is made to the rates of diffusion of various tanning agents and it is recalled that efforts have been made to utilise electrophoresis and electroosmosis to carry the tanning into the pelt. It is also observed that many patents have been taken out for the utilisation of vacuum to hasten the entrance of tanning into the hide. Reference is also made to our present knowledge on collagen and gelatin. J. K.

5117. Viscosity of Emulsions. E. G. Richardson. *Kolloid Zeits.* 65. *pp.* 32–37, *Oct.*, 1933.—Benzene-in-water emulsions exhibit marked structural viscosity, and there is a critical value of the rate of shear below which the emulsion does not flow. With water-in-benzene emulsions the form of the viscosity-rate of shear curve changes at high rates. For average rates the viscosity is given theoretically by $\eta_0 e^{k\varphi}$, where η_0 is the viscosity of the disperse medium and ϕ the volume of the disperse phase per c.c.; this expression has been verified for a number of systems. H. F. G.

5118. Mechanical Properties of Adsorption Layers, and Stability of Foam and Emulsions. D. L. Talmud. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp.* 420–430, 1933.—Methods of measuring the mechanical strength of adsorbed films and the principles underlying the stability of foam are reviewed. The results of determinations by the author of the strength of various adsorbed films are given in general terms and discussed. A study of the stability of foam with dissolved and non-dissolved adsorbed layers is discussed. The stability of normal and inverted emulsions is also dealt with. P. H. B.

5119. Ultracentrifuge. J. W. Beams, A. J. Weed and E. G. Pickels. *Science*, 78. *pp.* 338–340, *Oct.* 13, 1933.—This paper deals with the ultracentrifuge, which is rotated by a modification of the Henriot and Huguenard method for obtaining high rotational speeds [see Abstract

2013 (1925)]. Important variations and improvements in design on previous forms of apparatus are described. This air-driven type of ultracentrifuge offers the following advantages: (1) it is simple and easy to construct; (2) the design may be widely varied to suit the need of the experimenter, and still remain extremely stable; (3) the cost is very little if air pressure is already available; (4) the centrifugal forces developed are as high as any material (as yet tried) of the rotor will safely stand.
H. H. Ho.

5120. Lower Limit of the Particle Size in Disperse Systems. Gogoberidze. *Kolloid Zeits.* 65. *pp.* 24–25, *Oct.*, 1933.—Since the vapour pressure of a droplet increases with reduction of size, there will be a lower limit to the latter, *viz.*, the value at which the vapour pressure becomes equal to the atmospheric pressure. The limiting diameter, R, of a spherical droplet is given by $2\alpha\delta/(p^1 - p)(1033 - \delta)$, where α is the surface tension, δ the vapour density, and p and p^1 the vapour pressures over plane and curved surfaces of the liquid. The temperature effect is large, *e.g.*, for water droplets in air R rises from 7×10^{-8} cm. at 0° C. to 128×10^{-8} cm. at 50° C. A colloid will coagulate when the particle size becomes equal to the limiting size, and the ageing of colloids may be explained on this basis. Addition of capillary active substances to a colloidal solution lowers R and thus increases the stability of the system. H. F. G.

See also Abstracts 5101, 5109, 5410, 5429, 5444.

CRYSTAL STRUCTURE AND PROPERTIES.

5121. Mosaic Structure of Crystals. F. Blank. *Phys. Zeits.* 34. *pp.* 353–368, *May* 1, 1933.—It is known that certain crystal properties are not readily explained on the lattice theory. These difficulties have produced the work of Zwicky and others in attempts to establish the existence of secondary structure. The present report deals with the theoretical considerations involved, together with a résumé of the following experimental factors: microscopical, magnetic, electrical, thermal, X-ray determination of wave-length, interference. An extensive Bibliography concludes the paper. F. I. G. R.

5122. Allotropism of Beryllium. F. M. Jaeger and J. E. Zanstra. *K. Akad. Amsterdam, Proc.* 36. 6. *pp.* 636–644, 1933.—Following the abnormal thermal behaviour previously observed [see Abstract 641 (1933)], data for α-Be were obtained from X-ray rotation, oscillation and powder spectrograms. The last named contained a set of lines additional to the normal spectrum of α-Be, and were most distinct after the metal had been heated to 630° in vacuo for 10 hr. Corresponding spectrogram data for the metal so treated confirms these lines as due to a β-modification of Be for which the axial ratio $a : c = 1 : 1{\cdot}5211$, against $1 : 1{\cdot}5877$ for the α-form. The transition to α-form is impeded by strong passive resistances. The presence of the β-form in ordinary Be probably accounts for the known irregular and inconstant physical properties of the metal. N. M. B.

5123. Dependence of the Lattice Constant on the Hydrogen Concentration in the System Palladium-Hydrogen. G. Rosenhall. *Ann. d. Physik*, 18. 2. *pp.* 150–154, *Sept.*, 1933.—Earlier investigations have shown that the system palladium-hydrogen does not consist of one phase, but that a second phase occurs below a definite concentration of hydrogen.

As there is disagreement about the discontinuity the author has repeated the investigation and has measured the lattice constants and simultaneously the composition of the hydrogen-palladium system ; the measurement of the hydrogen content is carried out very accurately, the error being estimated at ± 0·005 H/Pd. His experiment shows at 600° C. a discontinuity at 0·64 H/Pd (which is in agreement with the results of Linde and Borelius), corresponding to a lattice-constant of 0·420 Å. By extrapolating the data a constant 0·411 Å is obtained for Pd – H.

H. L. B.

5124. Crystal Structure of the Compound MgPr. A. Rossi and A. Iandelli. *Accad. Lincei, Atti,* 18. *pp.* 156–161, *Aug.,* 1933.—Powder diagrams of this compound give the value $a_0 = 3 \cdot 88$ Å for the side of the unit cell ; the experimental density is 4·67. The unit cell contains one molecule and the arrangement of the atoms is cube-centred.

T. H. P.

5125. X-Ray Study of Binary Alloys of Silicon with Ag, Au, Pb, Sn, Zn, Cd, Sb and Bi. E. R. Jette and E. B. Gebert. *J. Chem. Phys.* 1. *pp.* 753–755, *Nov.,* 1933.—The lattice constants of the binary alloys of silicon with silver, gold, lead, tin, zinc, cadmium, antimony and bismuth have been measured. It is shown that the lattice constants of the elements in these alloys are practically identical with those of the pure elements. This fact leads to the interpretation that mutual solubility of the elements in these alloys occurs to only a very slight extent. It is further observed that silicon forms no compounds with any of these elements.

AUTHORS.

5126. X-Ray Diffraction and the Structure of Glasses. J. T. Randall and H. P. Rooksby. *Soc. Glass Technol., J.* 17. *pp.* 287–295, *Sept.,* 1933.—Earlier results on the diffraction of X-rays by glasses [see Abstract 718 (1931)] have been extended to include vitreous cadmium pyrophosphate, selenium, lithium metaborate, antimony and bismuth sesquioxides, lead metasilicate and a number of the more common glasses in everyday use. Figures are given for the band spacings of all glasses so far examined. In agreement with the previous work it is concluded that the diffraction bands can, in general, be explained in the basis of the idea of minute crystals or groups of atoms regularly arranged over very small volumes. The reasons for the formation of glasses are discussed in the light of the new experimental work. It is suggested that the probability of the formation of a glass is high for those substances, the normal crystalline forms of which are such that the forces binding the atoms together are either strongly directional or localised in character. The possibilities of understanding the patterns of the more complex commercial glasses are discussed. It is thought that the regular groups of atoms may not be so definite in composition or size as in the case of the simpler glasses. Finally the connection between this work and the more general problem of the melting of solid bodies is brought out and suggestions are made.

AUTHORS.

5127. Fourier Analysis of the Durene Structure. J. M. Robertson. *Roy. Soc., Proc.* 142. *pp.* 659–674, *Nov.* 1, 1933.—Durene (1.2.4.5. tetramethyl benzene) possesses a regular plane hexagon benzene ring : the methyl groups are coplanar with it, but displaced about 3° towards the unsubstituted positions. Centre-to-centre distance in the ring is about 1·41 Å, the centre of the methyl group lying about 1·47 Å from the adjacent aromatic centre. Shortest distance between methyl groups in neighbouring molecules is about 3·9 Å. F. I. G. R.

5128. Crystal Structure of Naphthalene. J. M. Robertson. *Roy. Soc., Proc.* 142. *pp.* 674–688, *Nov.* 1, 1933.—The interatomic distance of 1·41 Å is the same as in anthracene: closest distance of approach 3·60 Å, also nearly the same as in anthracene. F. I. G. R.

5129. Theory of Anisotropic Liquids. C. W. Oseen. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 17. *pp.* 1–27, 1933. *In German.*—The author has already given [see Abstracts 1409 (1930), 2958 and 3413 (1931)] a molecular-theoretical derivation of the differential equations determining the orientation of the molecules in liquid crystals. A simpler method is now evolved for obtaining these equations, which, in their present form, contain 54 constants. As shown earlier, this number is reduced to 13 in a certain case, and 5 of these are involved also in the author's theory of anisotropic liquids with rotation-symmetrical molecules. Special interest attaches to the structure in which, on passing along the layer, the molecules appear to execute a spin and a precession; such a structure is termed " double drilled." The optical phenomena produced by these structures when a perpendicular light ray meets them are considered, the assumption being made that the principal axis of the dielectric tensor coincides with the axis of spin. The intensity of the monochromatic light passing through depends on the thickness of the layer in such a way that it contains two magnitudes, both being periodic functions of the thickness but of different periods. There thus arises an elliptically polarised wave which undergoes total reflection, without change in the sense of the rotation, if the layer is sufficiently thick. In this case the intensity depends, as a first approximation, only on one of the two periodic magnitudes. T. H. P.

5130. Interferometric Examination of Cleavage Faces of Crystals. M. Siegbahn. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 12. *pp.* 1–9, 1933. *In German.*—Interferometric examination of the cleavage faces of crystals employed for X-ray spectroscopy reveals, in some cases, contours rising to as much as 0·0005 mm. Such crystals yield poor spectrograms. The best surfaces were found in calcite. C. B. A.

5131. Additive Colour Effects of Alkali Halide Crystals. Part III. E. Rexer. *Zeits. f. Physik,* 86. 1–2. *pp.* 1–13, *Oct.* 17, 1933.—A spectrophotometric investigation is recorded of the temperature dependence of additive colour effects in rock-salt, the following results being given: Strong red displacement of the absorption of amicroscopic colour centres; thermal instability of the colloid bands of untempered coloured crystals; spectral invariability and high stability of the colloid bands of high-tempered coloured crystals. Experiments are also described on the electron-mobility-mechanism of colour processes, and on the additive colour effects with vapours of foreign metals. [For Part II see Abstract 4101 (1932).] H. H. Ho.

5132. Geometrical Lattice Limitation of the Sliding Surfaces in Crystals. H. G. Sossinka, B. Schmidt and F. Sauerwald. *Zeits. f. Physik,* 85. 11–12. *pp.* 761–771, *Oct.* 14, 1933.—Even an accurate following up of the geometrical position of the atoms in space-lattices does not permit the ascertainment of a basis for the qualification of the actual most favourable surfaces as translation surfaces. It must therefore be concluded that the plasticity in general, also on the ground of this fact, must be looked upon not as a purely geometrical lattice problem, but actually as a problem of atomic physics, pending a better knowledge of the elements of sliding.

J. J. S.

5133. Inherent Limitation of Soller (Multiple) Slits. T. N. White. *Rev. Sci. Instruments*, 4. *pp.* 590–592, *Nov.*, 1933.—The characteristic X-radiation reflected from a crystal may at certain deviations from the Bragg angle be partly obstructed by the separating strips of the multiple slits, resulting in minima which give a single spectral line the appearance of a multiplet. Geometrical analysis and experimental proof are given. AUTHOR.

See also Abstracts 5139, 5141, 5180, 5261, 5351, 5352, 5375, 5376, 5412, 5414, 5415, 5453, 5461.

DENSITY.

5134. Densities and Parachors of Vinyl Acetate and Its Liquid Polymers. C. Green, J. Marsden and A. C. Cuthbertson. *Canad. J. of Research*, 9. *pp.* 396–401, *Oct.*, 1933.—The density of monomeric vinyl acetate has been determined over a range of temperature. The parachor and Ramsay and Shield's constant have been obtained for the monomer and some liquid polymers. On the assumption that a liquid polymer may be considered as a solution of a dimer in the monomer, parachors were calculated from the mixture law. If Staudinger's formula be assumed for the dimer the calculated and observed parachors agree to within 1 %.

AUTHORS.

5135. Determination of Small Changes in the Density of a Liquid. P. C. Vincent. *Phys. Soc., Proc.* 45. *pp.* 833–835, *Nov.* 1, 1933. —The paper describes a manometer method for determining changes in the density of water due to prolonged contact with glass. [See Abstract 5145 (1933).] AUTHOR.

5136. Micropyknometer for Estimation of Variations in the Isotope Ratio of Water. E. S. Gilfillan and M. Polanyi. *Zeits. f. phys. Chem.* 166. *Abt.A.* 3–4. *pp.* 254–256, *Sept.*, 1933.—The micropyknometer consists of a hollow glass sphere slightly flattened to render its volume sensitive to changes of pressure, and an attached open vessel. The whole pyknometer is about 6 mm. long and 1 mm. wide, and is so constructed that it has the same density as water at 0° C. It is placed in the water sample, the pressure on which is adjusted so that the pyknometer neither sinks nor rises when the temperature is constant. A change of pressure of 1 cm. Hg corresponds to a change in upthrust of about 10^{-4} mg. The equilibrium pressure can be determined within 1 or 2 mm. of Hg.

P. H. B.

See also Abstracts 5367, 5372.

DIFFUSION AND OSMOSIS.

5137. Diffusion Coefficients of Bromine-Argon, Bromine-Methane, Bromine-Hydrogen Chloride, Bromine-Nitrous Oxide. J. E. Mackenzie and H. W. Melville. *Roy. Soc. Edinburgh, Proc.* 53. 3. *pp.* 255–259, 1932–1933.—The diffusion coefficient of Br_2-A, Br_2-CH_4,

Br_2-HCl, and Br_2-N_2O have been determined by a visual method. Preliminary experiments, in which photoelectric measurements replace those made visually, are described. The results thus obtained confirm those got by the visual method. [See also Abstract 4031 (1932).] AUTHORS.

See also Abstracts 5115, 5179, 5369.

ELASTICITY AND PLASTICITY.

5138. Equilibrium of a Solid Supported on an Elastic Surface. V. Valcovici. *Comptes Rendus*, 197. *pp.* 739–740, *Oct.* 9, 1933.—When a rigid body is supported at *n* points upon a rigid surface, only six equations are available for determining the *n* reactions. If, however, the surface is elastic, *n* equations may be obtained, thus completely determining the reactions. J. P. A.

5139. Elastic Properties of Alloys and of Mixed Crystal Series. H. Röhl. *Ann. d. Physik*, 18. 2. *pp.* 155–168, *Sept.*, 1933.—A study of the effects of thermal and other treatment upon (*a*) the Au-Cu and the Au-Pd mixed crystal series, and (*b*) the alloys Cu_3Pt, Cu_3Pd, and CuPd. The principal measurements are of the moduli of torsional and longitudinal elasticity, but check observations of electrical resistance, and, for the Au-Pd system, of the reflecting power, are given. The effects on the Au-Pd specimens produced by charging them with hydrogen are investigated. The results are summarised in diagrams and tables. J. P. A.

5140. Elasticity of Ferromagnetic Materials. M. Kersten. *Zeits. f. Physik*, 85. 11–12. *pp.* 708–716, *Oct.* 14, 1933.—The modulus of elasticity of a ferromagnetic material is greater for the magnetically saturated than for the demagnetised state. An explanation of this effect, on the lines of a theory due to **R. Becker** [see Abstract 1215 (1933)] is given. The factors involved are the elasticity, the magnetostriction, and the initial state of internal stress of the material. The relation between these quantities and the temperature coefficient of elasticity is worked out, and an explanation is offered of the anomalous variation of elasticity near the Curie point. The state of balance giving rise to zero temperature-coefficient of elasticity in elinvar alloys, is dealt with. J. P. A.

5141. Plasticity and Hardness of Alkali Halide Crystals. Part II. K. Przibram. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 5–6. *pp.* 259–261, 1933.—The plasticity coefficient *b*, previously defined [see Abstract 2171 (1933)], and the Brinell hardness have been determined for NaBr and NaI, and KI. For the same kation the value of *b* is, as a first approximation, a linear function of the lattice constant. T. H. P.

5142. Torsional Oscillations in a Conical Rod. B. Sen. *Zeits. f. techn. Physik*. 14. 10. *pp.* 428–429, 1933.—The periods of torsional oscillations in a conical rod, when a cap extending from the apex is maintained at rest, are worked out in terms of Bessel functions. J. P. A.

5143. Strength of Glass. J. B. Murgatroyd. *Soc. Glass Technol., J.* 17. *pp.* 260–272, *Sept.*, 1933.—The paper discusses the strength of glass with reference to the surface condition. Experiments on the thermal endurance of scratched bottles are quoted which demonstrate that scratches greater in magnitude than those deduced to be present by Griffith lower the thermal endurance, whereas smaller scratches do not affect this property. Methods of reducing the effect of surface flaws by fusing substances on glass surfaces are also discussed. The strength of glass is regarded as dependent on the chance of a surface flaw being correctly oriented to the principal stress, and the theory is applied to the thermal endurance of glass rods. It is deduced that the phenomenon of fatigue under repeated alternating stresses should not be shown by glass, and that strong glasses should have weakly defined transition points. The conditions for making a " strong " glass are also briefly discussed.

AUTHOR.

5144. Stresses in Flashed Glasses. W. M. Hampton. *Soc. Glass Technol., J.* 17 *pp.* 273–286, *Sept.*, 1933.—The paper gives the results of a mathematical investigation into the stress distribution present in a system consisting of two or more glasses fused together. The stress distribution is first worked out for the case of a doublet system where the coefficients of expansion of the two glasses are slightly dissimilar. The two cases are distinguished, first, where the strip is free to bend, and secondly, where it is rigidly held at the ends, as this approximates to the conditions for the manufacture of such articles as globes. The effect of varying the thickness of the portions of the sheet is discussed, and curves are drawn for the stress distribution, showing close agreement with actual photographs taken by means of a Babinet compensator. By a modification of the equations, a method is indicated whereby an estimate of the difference in coefficient of expansion of two glasses can be obtained from a measurement of the curvature of two rods which are drawn together. In the second portion of the paper, the distribution is worked out for the case of three glasses fused together; and subsequently the practical case where the two outer glasses are of one composition, and the inner glass of another, is worked out in detail. Again, typical instances are computed and the results compared with actual photographs. AUTHOR.

5145. Sensitive Manometer. P. C. Vincent. *Phys. Soc., Proc.* 45. *pp.* 808–832, *Nov.* 1, 1933.—The manometer is analogous to a U-tube water manometer but the air is replaced by pure air-free water, and the water is replaced by an aqueous solution of uranine whose density differs from that of pure water. When the apparatus was made of glass, errors arose from the solution of the glass by water, which increased the density of the feeble uranine solution. The manometer functioned well when the apparatus was made of silica, which is almost insoluble in water. In order to test the working of the manometer, the pressures given directly by it were compared with those calculated from measured rates of flow along a capillary tube. As the ends of the manometer liquid become diffuse in the course of time, the rate of flow was measured by means of a coloured index, and as the index became considerably distorted a special method was devised for determining its position. The difference of pressure measured varied in value from about 2 dynes/cm^2. to about 20 dynes/cm^2. The average numerical difference between the direct manometer readings and the calculated readings is about 1 % of the absolute readings. The average difference taking the sign of the difference into account is about $\frac{1}{3}$ %. [See also Abstract 5135 (1933).] AUTHOR.

See also Abstracts 5096, 5279, 5368.

GRAVITATION.

5146. Variations of Gravity with Time. R. Tomaschek. *Ergeb. d. exakt. Naturwiss.* 12. *pp.* 36–81, 1933.—Influences that effect a change in the gravity vector relative to the earth's surface are specified, chief among them the attractions of the moon (owing to close proximity) and the sun (owing to great mass). A theory is given of the tidal fluctuations of the gravitational force on a rigid and a yielding earth. In the latter case the earth is first considered elastic but without an ocean; then the effect of the presence of the oceans is estimated, and lastly also the influence of the motion of the earth through space. An account is given of the methods used and results obtained in (1) determining the changes in the direction of the acceleration due to gravity, and (2) in determining the fluctuations in the values of the gravitational forces (statical methods and gravimeter). The author gives an interpretation of the results obtained and discusses the influence of the motion of the earth in space in general. Results are also given for the deformation of the earth. H. L. B.

HYDRODYNAMICS AND AERODYNAMICS.

5147. Plane Motion of a Perfect Incompressible Liquid. A. Gay. *Comptes Rendus*, 197. *pp*. 741–742, *Oct*. 9, 1933.—Integral expressions derived by separating real and imaginary parts of a contour integral involving $w(=u+iv)$ are used in the discussion of classical problems due to Dirichlet and Hilbert. J. S. G. T.

5148. Rigorous Determination of Permanent Periodic Waves of Finite Amplitude. (Miss) M. L. Dubreil-Jacotin. *Comptes Rendus*, 197. *pp*. 818–821, *Oct*. 16, 1933.—A rigorous solution of the propagation in a vertical plane of two-dimensional waves in a fluid of infinite depth, is discussed. The solution indicates the existence of an infinity of waves comprising as particular cases those discussed by Gerstner and by Levi-Civita. J. S. G. T.

5149. Flow Past Circular Cylinders at Low Speeds. A. Thom. *Roy. Soc., Proc*. 141. *pp*. 651–669, *Sept*. 1, 1933.—An arithmetical method of solving the equations of viscous flow is developed in which, by successive approximations, the new values are interpolated in a manner which involves solution of the fundamental equations. In a development of the method an auxiliary solution is used to give first a conformal network for the boundaries. The flow past a circular cylinder at Reynolds number 20 is calculated, and values for the drag and pressure distribution are found to agree with observed values obtained with Reynolds numbers between 3·5 and 200. Photographs of streamlines past a cylinder show the development of the symmetrical stationary eddies behind the cylinder as the speed increases, and the subsequent formation of the Kármán street; the Reynolds number at which the latter develops is influenced by the pressure of the walls. H. F. G.

5150. Small Oscillations in an Isolated Body of Liquid. W. Jardetzky. *Comptes Rendus*, 197. *pp*. 577–579, *Sept*. 4, 1933.—Mathematical. Equations are derived for the cases of compressible and incompressible liquids. The expression for the period in the second case is equivalent to that of Kelvin when the oscillations are infinitely small. H. F. G.

5151. Flow of Viscous Liquid Past Spinning Bodies. T. E. Garstang. *Roy. Soc., Proc*. 142. *pp*. 491–508, *Nov*. 1, 1933.—The flow of viscous liquid past a spinning sphere is investigated mathematically, Oseen's approximate equations being used to determine coefficients from boundary conditions. When the sphere is rotating about an axis, y, perpendicular to the direction, x, of the stream, observation requires that there should be a lifting force on the sphere perpendicular to both x and y, the sign of the force being, in general, in accordance with the Kutta-Joukowski theorem for a perfect fluid. The force, calculated from integrals taken over the sphere is found to be opposite in direction to that given by this theorem; calculated from integrals at infinity the lift is zero. A somewhat similar discrepancy is found in the case of a rotating circular cylinder. Using integrals at infinity, the lift agrees with that derived from the Kutta-Joukowski theorem; the calculation by integrals over the cylinder gives half this value. The discrepancy is attributable to neglect of inertia terms in $u\partial u/\partial x$, etc. It is concluded that if Oseen's equations are used to determine coefficients from boundary conditions, no reliance can be placed upon obtaining a good approximation to the motion either near the solid or at infinity. J. S. G. T.

5152. Two-Dimensional Steady Flow of a Viscous Fluid Behind a Solid Body. Parts I and II. S. Goldstein and A. Fage. *Roy. Soc., Proc.* 142. *pp.* 545-573, *Nov.* 1, 1933.—I. The calculation of the velocity distribution in the wake behind an infinitely thin plate parallel to a stream, discussed in a previous paper [see Abstract 2066 (1930)] is completed. First and second approximations to the distribution, derived by the application of Prandtl's boundary layer equations are derived; a third approximation cannot be obtained in this manner. The result suggests that the steady motion is unstable at some distance behind the plate; this is confirmed by experimental results obtained by Fage and Falkner. II. The general formulæ deduced in I are compared with results of calculations made by Filon [see Abstract 2046 (1928)] not employing the boundary layer theory. For a symmetrical wake, Filon's formulæ reduce, in the case of small viscosity, to those given here; the additional terms necessary when the viscosity is not small, are given in simplified form. For an asymmetrical obstacle, it is shown that the infinite term derived by Filon in his calculation of the torque on the obstacle, is accounted for if allowance is made for displacement of the wake, in the actual motion from the symmetrical position it occupies according to the first approximation. J. S. G. T.

5153. Stability for Three-Dimensional Disturbances of Viscous Fluid Flow between Parallel Walls. H. B. Squire. *Roy. Soc., Proc.* 142. *pp.* 621–628, *Nov.* 1, 1933.—The stability of the flow of a viscous fluid between parallel walls for three-dimensional disturbances is discussed. A fourth-order differential equation is derived and it is shown that, if any velocity profile is unstable for a particular value of Reynolds' number, it will be unstable at a lower value of Reynolds' number for two-dimensional disturbances. Further, all profiles are shown to be stable for disturbances of a certain degenerate type. AUTHOR.

5154. Thermoelectric Measurement of Fluid Flow. A. Égal. *Comptes Rendus,* 197. *pp.* 910–913, *Oct.* 23, 1933.—Other methods of measurement involving the use of a Pitot or Venturi tubes, vanes, hot wire or chemical methods require the apparatus in the centre of the region of flow. In this method a series of thermocouples make contact at one set of junctions inside the pipe, with the fluid, and are maintained outside at a fixed controllable temperature. The potential difference is thus proportional to the rate of flow of the fluid. Diagrams illustrate in full details of the apparatus. The method is applicable to all liquids and gases with tubes even of large dimensions. R. S. R.

5155. Turbulent Flow through Fine Eccentric Clearances. R. J. Cornish. *Phil. Mag.* 16. *pp.* 897–912, *Nov.,* 1933.—It is shown that the flow through a fine eccentric clearance may be laminar, turbulent, or laminar in the narrower portions and turbulent in the wider portions. A general formula is developed to cover all three cases, and the increased quantities corresponding to a range of values of the eccentricity ratio are calculated. It is proved that, with smooth boundaries, the maximum increase with turbulent flow is 31·5 per cent. The results of experiments by J. Caldwell [see Abstract 1278B (1930)] and by the author are shown to agree closely with the predicted results. The paper concludes with a note on the use of the hydraulic mean depth in coordinating the resistance curves for turbulent flow through different forms of conduit. [See also Abstract 2763 (1933).] AUTHOR.

5156. Direct Measurement of Low Air Speeds. M. Ziegler. *K. Akad. Amsterdam, Proc.* 36. 4. *pp.* 426–431, 1933.—Describes a method which can be used for measuring rates of air flow down to about 10 cm. per sec. A heater is placed at one point in the stream and at a convenient measured distance down-stream is a fine platinum wire carrying a very small current. Any change in the temperature of the air stream alters the resistance of the wire and therefore the strength of the current. The heater consists of a wire grid through which a condenser is discharged, and by means of an oscillograph the time interval between the condenser discharge and the increase in the current through the wire may be measured accurately. Full details of the instrument and of the method of use are given in the paper. J. W. T. W.

5157. Reducing Resistance to Motion through a Fluid. S. Nikitine. *Comptes Rendus,* 197. *pp.* 896–898, *Oct.* 23, 1933.—The resistance experienced by a body in passing through a fluid is reduced if the density of the fluid is reduced. The author has carried out some experiments with solid bodies travelling in water, arrangements being made for air to be ejected from the solids so that it forms a layer intermediate between the body and the surrounding water. The reduction of the resistance depends on the speed of the body and on the rate at which the air is ejected. A maximum reduction of 36 % was recorded for a circular cylinder. Experiments were also made with a wing section, with similar results. J. W. T. W.

5158. Flow Past an Obstacle between Parallel Plates. L. Sackmann. *Comptes Rendus,* 197. *pp.* 898–900, *Oct.* 23, 1933.—The author has studied the changes which take place in the mode of flow past an obstacle as the distance between the two plates which confine the fluid is altered from a small value to something which, in effect, gives the same results as an infinite distance. The effect of the viscosity of the fluid becomes more and more pronounced as the distance between the plates is diminished. J. W. T. W.

5159. Striation in the Boundary Layer Surrounding a Solid. D. Riabouchinsky. *Comptes Rendus,* 197. *pp.* 900–902, *Oct.* 23, 1933.—The author has studied the striation which can be detected in the boundary layer surrounding a body moving through a gas. The work has been extended to include high relative velocities (450 m. per sec.) between the body and the gas [see also following Abstract]. J. W. T. W.

5160. Striation in the Boundary Layer Surrounding a Solid. V. Volkovisky. *Comptes Rendus,* 197. *pp.* 902–905, *Oct.* 23, 1933.—The author gives some examples of the records of the striations found in the boundary layer surrounding a solid when it moves very rapidly through a gas [see preceding Abstract]. These records were obtained by coating the surface of the body with oil paint and then directing a jet of air past the body, the velocity of the jet at the nozzle being greater than that of sound. Records are shown for three different distances of the solid from the nozzle. J. W. T. W.

5161. Laws of Fluid Mechanics. W. F. Durand. *Science,* 78. *pp.* 343–351, *Oct.* 20, 1933.—The author first surveys the history of the study of fluid flow and of the motion of an object through a gas or a liquid. After a discussion of the work of Newton he considers the later developments in the study of the perfect non-viscous fluid. Following this he describes the work of Stokes, Poiseuille and Osborne Reynolds on viscous fluids, and, finally, the great advances due to the Prandtl school. The reason why the theory of Kutta and Joukowski for an ideal fluid gives such an adequate solution of the problem of lift is explained in general terms. The whole paper is very general in character and is intended to show the advances which have been made, the present state of the theory, and the directions in which progress is taking place. J. W. T. W.

See also Abstract 5279.

KINETIC THEORY OF MATTER.

See Abstracts 5188, 5189.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

5162. Estimation of Tenths on a Scale. H. Bäckström. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 21. *pp.* 1–43, 1933. *In English.*—An investigation of the systematic errors occurring in the decimal estimation of the readings on scales is described where the index is the dividing-line between a dark and a light area, such as on thermometers and burettes. The case of a straight dividing-line is considered in the present paper but the work is to be extended to curved index-lines. For any one observer the estimated ranges for the different decimals have sharply defined limits which are remarkably constant, but the limits vary for different observers. If the dark area is underneath the index-line the estimated readings are generally too high and it is shown by experiments with scale-lines of different known thicknesses that, for the 7 observers tested, the estimations near a scale-line appear to be automatically related not to the middle of the line but to its upper edge. The opposite effect occurs when the system is inverted. A method is described of calculating the average error in decimal estimations on scales of the type concerned. H. B.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

5163. Rod Rider for High-Precision Balance. L. Ramberg. *Arkiv f. Kem. Min. och Geologie,* 11*A*. 7. [24 *pp*.], 1933.—After an analysis of the errors in high precision weighing (accuracy of 0·001 mg.) due to slight variations in the position of the wire rider of the usual type when lowered into the notches of the rider beam, the author describes a rider construction which greatly reduces errors of this kind. The new ride consists of a cylindrical rod of quartz glass of mass 2 mg., length 6 mm., diameter about 1 mm. or less, and a special transporter mechanism allows the rider to be lowered to lie transversely in the notches of the rider beam. A balance using a rod rider of this type has been in use for a year and has proved very satisfactory. Special tests indicate that errors due to misplacing of the rider lie within the limits set by the accuracy demanded (0·001 mg.). W. S. S.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

5164. Calculation of Characteristic Values for Periodic Potentials. H. D. Koenig. *Phys. Rev.* 44. *pp.* 657–665, *Oct.* 15, 1933.—The author reviews the general properties of the solutions of differential equations with periodic coefficients, the so-called Hill and Mathieu equations. Asymptotic formulæ for the eigenvalues of the Mathieu equation in the oscillatory region are obtained by applying the Schrödinger perturbation theory to the problem of the physical pendulum. The W. K. B. method is applied to the Hill equations. Implicit equations for the eigenvalues are obtained. They are valid for $E < V_{max}$. In the introduction a group of physical problems are mentioned, to which the results may be applied. AUTHOR.

5165. Generalised Propagation Representing Waves or Moving Particles. A. Buhl. *Comptes Rendus,* 197. *pp.* 822–824, *Oct.* 16, 1933.—The equations of propagation of a physical quantity, whether corpuscular or undulatory, can be derived from the vanishing of divergences. G. C. McV.

5166. "Spread" as a Measure of Deviation in Physical Measurements. E. Q. Adams. *Rev. Sci. Instruments,* 4. *pp.* 620–623, *Nov.,* 1933.—To compare results of incandescent lamp tests expressed in terms of the spread (maximum difference) observed in sets of various numbers of lamps, factors were required to convert these results to a comparable basis. The average deviation of a single observation was chosen as the basis of comparison. To avoid the necessity of computing the probable error, a table of the probability integral for the argument $\tau = \pi^{\frac{1}{2}}t$ is given. Assuming a Gaussian distribution of errors, the factors have been tabulated for numbers of observations up to 100,000. They are given approximately by the semi-empirical formulæ : spread/average deviation $= f(n) = 2\pi^{\frac{1}{2}}t_a = (5_0296 - 2_0086/(0_045 + \log n))(\log n)^{\frac{1}{2}} = 5_07\ (\log n)^{\frac{1}{2}} - 1_075$. While the average deviation so computed is less precise than that computed from the sum of the residuals, or *a fortiori* of their squares, the difference seldom exceeds the uncertainty of the more refined measures. Conventions are suggested for the retention of figures and for the statement of measures of deviation. The labour of computing the average deviation from the spread is so slight that an expression of the internal consistency of *all* results of physical measurements may reasonably be required. AUTHOR.

5167. Theory of Probability. C. W. Oseen. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 16. *pp.* 1–10, 1933. *In German.*—Discusses von Mises' theory (*Wahrscheinlichkeit, Statistik und Wahrheit,* Berlin, 1928) of the *Kollektiv,* and shows that though there are serious difficulties in the way of its acceptance it is still capable of rendering some good service. Proceeds to discuss the foundations of the classical statistical theory; and shows that even after all that has been done, this has as yet no exact basis. A. D.

5168. Experimental Investigation of Probability. A. L. Clark, *Canad. J. of Research*, 9. *pp*. 402–414, *Oct*., 1933.—An experimental determination of probability is described in this paper. Steel balls were dropped on to a horizontal plate pierced with holes in regular array, and the number which passed through without contact with the plate was observed. The ratio of the number of free passages to the total number of balls dropped is the experimental probability, and this number was found to be in very close agreement with the probability calculated from measurement of the balls and holes. Since this calculated probability involves π, the experimental probability may be used to calculate π which was found to be $3{\cdot}143 \pm {\cdot}005$. The paper closes with a brief discussion of the application of probability to certain problems in physics. AUTHOR.

5169. Mathematical Transformation of the Set-Square Index Nomogram. H. J. Allcock. *Phil. Mag*. 16. *pp*. 744–760, *Oct*., 1933.—The set-square-index nomogram (and its associated form the parallel-index nomogram) is regarded as a double-alignment nomogram with a reference-line situated at infinity. It then follows that the parallel lines defining the limits of the rectangular set-square-index nomogram will, in the corresponding double-alignment nomogram before final transformation, intersect on the reference-line. A relationship exists between the four limiting values of the two variables in any one half of the nomogram, such that, three of them being chosen, the fourth is definitely fixed. For any given set of limiting values, therefore, it may not be possible for a rectangular transformation to be made. The latter possibility is a serious limitation to the practical utility of this type of nomogram, resulting often in an inconvenient figure and consequent inaccuracies in use. Preferably, therefore, use should be made of some other type, such as the double-alignment or the grid nomogram, unless there are particular reasons for the above. H. H. Ho.

See also Abstracts 5162, 5247, 5362.

MECHANICS, CLASSICAL.

5170. Amplitudes of Non-Harmonic Vibrations. J. P. den Hartog. *Frank. Inst., J*. 216. *pp*. 459–473, *Oct*., 1933.—Two new approximate graphical solutions are given for the problem of forced vibration of an undamped single degree of freedom vibrating system with a non-linear spring, whose characteristic is given in the form of a curve. One of these solutions gives much more accurate results than the approximation known so far. AUTHOR.

5171. General Properties of Resonance in Non-Linear Mechanics. N. Kryloff and N. Bogoliùboff. *Comptes Rendus*, 197. *pp*. 908–910, *Oct*. 23, 1933.—The authors consider the case of two feebly coupled conservative systems and obtains the conditions for the existence of zones of resonance and the change of amplitude as one recedes from the zone of resonance. He shows that the phenomena of non-linear resonance depend on the initial value of the angular variable and it is only when distant from resonance that the effect of this dependence is enfeebled. The case with important applications is that in which the Hamiltonian perturbator is a sine function of the time and then the only notable resonances are those of submultiplication having for their proper frequency a value near to a submultiple of the original frequency. Then, outside the zone of resonance, effects analogous to those of Raman with specified frequencies occur. R. S. R.

See also Abstracts 5119, 5167, 5173.

MECHANICS, QUANTUM.

5172. Molecular Symmetry and the Reduction of the Secular Equation. H. Eyring, A. A. Frost and J. Turkevich. *J. Chem. Phys.* 1. *pp.* 777–783, *Nov.*, 1933.—A method is given for expressing a bond eigenfunction of any multiplicity in terms of a linear independent set. The independent sets for the multiplicities corresponding to one bond and to two bonds for an arbitrary number of electrons are given. A method recently given for obtaining matrix components for singlet bond eigenfunctions is generalised to include all multiplicities. Group theory is applied to the bond eigenfunctions for symmetrical molecules to reduce the secular equation and examples are worked out for all multiplicities. The possible reasons for the approximate additivity of bond energies for molecules is examined in connection with the chemist's custom of ignoring all but the strongest bonds. AUTHORS.

5173. Causality and Physics. R. Hönigswald. *Preuss. Akad. Wiss. Berlin, Ber.* 17. *pp.* 568–578, 1933.—A philosophical discussion of the concepts of physics and their relations to the concept of causality. G. C. McV.

See also Abstracts 5164, 5165, 5177, 5322, 5462.

RELATIVITY AND ETHER.

5174. Ether Hypothesis Due to Poincaré. J. Leroux. *Comptes Rendus*, 197. *pp.* 816–818, *Oct.* 16, 1933.—Poincaré, in order to explain the result of the Michelson experiment, suggested that the ether was modified in the neighbourhood of matter, the wave surface thereat becoming ellipsoidal. The same wave surface will serve for different frames of reference in uniform rectilinear motion ; a change of origin only is required when the frame of reference is changed. The author shows that a variable, *t*, satisfying the requirements of Einsteinian time, can be associated with the frames of reference so that velocities calculated by employing *t* as time, are in accord with the Lorentz hypothesis. Conversely the Poincaré hypothesis is derivable from that of Lorentz. J. S. G. T.

5175. Gravitational Field of the Electron. J. Ghosh. *Zeits. f. Physik*, 85. 7–8. *pp.* 511–513, *Sept.* 23, 1933.—By using the equations $K_{pq}-\frac{1}{2}g_{pq}K=-8\pi E_{pq}$ which was suggested by Einstein in 1926 for the equations of an electromagnetic field the author derives the gravitational field of the electron. H. L. B.

5176. Formulation of the Laws of Nature in Terms of Five Homogeneous Coordinates. W. Pauli. *Ann. d. Physik*, 18. 3. *pp.* 305–336, *Oct.*, 1933.—The theory of a five-fold projective geometry applicable to a Riemannian space of four dimensions is worked out. A symmetric connection in the projective five-space is assumed and an extended definition of geodesics is employed. When applied to physical space-time these geodesics give not only the paths of uncharged, but also of charged particles and the electromagnetic force tensor receives a natural geometrical interpretation. The field-equations are obtained by variation of an integral involving the scalar curvature of the projective five-space only and are the same as the gravitational equations of general relativity in an electromagnetic field, together with Maxwell's equations. The theory thus provides a simple unified field theory of the electromagnetic and gravitational fields in the absence of matter. G. C. McV.

5177. Integral Theory of Field and Matter. R. Zaycoff. *Zeits. f. Physik*, 85. 11–12. *pp*. 788–794, *Oct.* 14, 1933.—Gravitation, electromagnetism and cohesion pressure of matter find their natural place in a general metrical space of five dimensions. Dirac's wave mechanics may be brought into a five-dimensional co-variant form in which no surplus magnitudes occur and which is valid for all corpuscles of matter. Finally the activity function of the total field and of the matter waves is put forward. J. J. S.

5178. World-Structure. E. A. Milne. *Roy. Astron. Soc., M.N.* 93. *pp*. 668–680, *Oct.*, 1933. *Supplement.*—The author replies to criticisms brought against his theory of the expanding universe by Robertson [see Abstract 4786 (1933)] and by Kermack and McCrea [see Abstract 3947 (1933)], and gives his reasons for believing that his theory is not merely equivalent to a special case of general relativity. He lays stress on the possibility of an observer constructing a simple world-picture provided that the distance of an event from the observer and the time taken by a light pulse to travel this distance have certain pre-assigned meanings. He points out that his postulate of the equivalence of the world-views so constructed has a greater content than the homogeneity postulate of general relativity which asserts that the local experiences of two observers are the same. G. C. McV.

See also Abstract 5462.

SOLUTION.

5179. Theory of Concentrated Solutions of Strong Electrolytes. G. B. Bonino and G. Centola. *Accad. Lincei, Atti*, 18. *pp*. 145–149, *Aug.*, 1933.—Following the previous calculation of the coefficients of activity of the ions of strong electrolytes in concentrated solution, these calculations are developed in the present paper so as to be able to arrive at the theoretical prevision of the osmotic coefficients of the solutions by being able to subject the theory to a control with new experimental data deduced from other types of equilibrium in solutions of electrolytes. J. J. S.

SURFACE TENSION AND COHESION.

5180. Range of Surface Forces. F. P. Bowden. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp*. 185–196, 1933. *In English.*—Measurements have been made of the mechanical properties of gas, vapour, liquid and solid films in contact with highly polished surfaces. In the case of gases, vapours and liquids, no evidence was found for the existence of oriented molecular chains 50,000 Å long possessing a sufficient rigidity to withstand a steady pressure of shear equivalent to several grams weight. If such rigid chains are formed their length is under 1000 Å and probably much smaller. The presence of a surface can affect the way in which the crystals grow in a solidifying film (or liquid crystal) and this effect can extend a considerable distance from the surface. AUTHOR.

5181. Structure of Surface Films. Part XVIII. N. K. Adam and J. G. F. Miller. *Roy. Soc., Proc.* 142. *pp.* 401–415, *Nov.* 1, 1933.—Monomolecular surface films of fatty acids have been studied in detail over the complete range of acidity between strong alkali and dilute acid, especially on the alkaline side. Electrolytic dissociation, progressively increasing from neutral to alkaline solutions, causes a very marked decrease in lateral adhesion both in condensed and in expanded films. Minor specific effects of buffer salts on this adhesion are also found. Collapse occurs, to ultramicroscopic aggregates, on the more alkaline solution, but this is prevented if strong concentrations ($2N$) of salt are present. Bimolecular films are not formed. Concentrations of salt sufficient to retard collapse on alkaline solutions tend to increase the size of the end groups, probably by adsorption of kations. The change in packing of the condensed films from close-packed chains (the form found on alkaline solutions) to close-packed heads, usually occurs within a small range of pH, the exact value of which depends somewhat on the buffers present. [For Part XVII see Abstract 2670 (1933.] AUTHORS.

5182. Structure of Surface Films. Part XIX. N. K. Adam and J. G. F. Miller. *Roy. Soc., Proc.* 142. *pp.* 416–422, *Nov.* 1, 1933.—Monomolecular films of numerous substances with ionisable end groups show a marked decrease in lateral adhesion, when the alkalinity of the solution is changed so as to ionise the end groups. Substances with non-ionisable end groups do not show this effect. Strong soda solutions tend to increase the size of carboxyl or phenolic groups at the end of the molecule. Films of methyl palmitate are fairly rapidly hydrolysed on $2N$ caustic soda. [See preceding Abstract.] AUTHORS.

5183. Orientation of Molecules at Boundary Surfaces. H. Freundlich. *Ergeb. d. exakt. Naturwiss.* 12. *pp.* 82–114, 1933.—A brief history is given of the earlier researches on the changes of surface-tension of water caused by thin layers of oil, whose thickness varies from several Ångströms (monomolecular layer) to, say, 70 Å. A detailed account of Langmuir's balance (two-dimensional differential manometer) for measuring surface tension follows. It is shown that in the case of layers of insoluble organic substances the capillary relationships become more complicated, owing to the different possibilities of " packing " of the molecules. The phenomenon discovered in the case of these insoluble substances of high molecular weight are also found to occur, as was shown by Langmuir, in the case of truly soluble organic substances of low molecular weight. The author describes the properties of the layers that result from the adsorption of the organic molecules at the boundary with the gaseous phase. A discussion is given of the vertical position of the molecules in dense surface layers and of the doubts that arise about the position when the adsorption layers are dilute. It is not certain that the chains of molecules then lie horizontally. These results are then compared with others involving the electrical and structural conditions at the boundary surfaces. Layers that arise from colloidal solutions are also discussed, and the experimental work done with boundary surfaces of other types are briefly reviewed. H. L. B.

5184. Electrocapillary Experiments. I. G. Walters. *Phil. Mag.* 16. *pp.* 617–625, *Sept.*, 1933.—Measurements in the vertical capillary tube electrometer with $0{\cdot}02N$ to saturated KCl solutions show that on dilution the curves become flatter and the maximum displacement of the meniscus less. The slow rate of movement of the meniscus in very dilute solutions is ascribed to the facts that the relative changes of ionic concentration at the interface, and consequently the surface tension changes, are relatively small, and that the ions, being more hydrated than in concentrated solutions, move more slowly. The electrocapillary curves obtained for 0·5*N* KCl and KI solutions, and for mixtures of the two, demonstrate the capillary activity of the iodide ions, which are adsorbed at the interface to the exclusion of the chloride ions. For a saturated solution of KCl in methyl alcohol the maximum is greatly depressed as compared with saturated aqueous solutions, owing to the relatively low concentration, and the curve is much flatter. H. F. G.

5185. Theory of Electrocapillarity. Part I. S. R. Craxford, O. Gatty and J. St. L. Philpot. *Phil. Mag.* 16. *pp.* 849–864, *Nov.*, 1933. —The surface tension of a liquid-liquid interphase is defined in such a way as to be applicable to any desired boundary in an interphase of finite thickness. A generalised apparatus for doing surface work is discussed, and also the degrees of freedom of systems containing interphases of variable area. This discussion involves extensive degrees of freedom, and so leads to a restatement of the phase rule. It is shown that measurements of surface tension in reality involve several interphases and also volume changes in the bulk phases. AUTHORS.

5186. Surface Tension of Solids. W. P. Berdennikow. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp.* 397–419, 1933.—The surface tension of glass in contact with several media was determined with the aid of Griffiths' theory of the spreading of surface cracks by applying tension to a glass plate having a surface crack of measured length perpendicular to the direction of tension. It was found that the surface tension is maximum when the sample is in a vacuum. When the solid is wetted the greater the polarisation of the wetting liquid the greater is the reduction of the surface tension. P. H. B.

See also Abstracts 5109, 5118, 5134, 5373, 5432.

VACUA, HIGH.

5187. Vacuum Measurements by Means of Hot Wires. H. Murmann. *Zeits. f. Physik*, 86. 1–2. *pp.* 14–20, *Oct.* 17, 1933.— It is shown that the maximum sensitivity of a hot-conductor manometer is independent of the size and shape of the conductor cross-section, and experimental results are given for hot wires of different diameters. Sensitivity is discussed from the standpoint of properties of materials and operational data. H. H. Ho.

5188. Correction for Thermo-Molecular Flow. F. C. Tompkins and D. E. Wheeler. *Faraday Soc., Trans.* 29. *pp.* 1248–1254, *Nov.*, 1933.—The phenomenon of thermal transpiration must be taken into account when pressures in evacuated apparatus are to be measured, particularly where large temperature gradients exist. The magnitude of the effect in the typical case of an evacuated bulb immersed in liquid oxygen is investigated experimentally, and the upper limit of pressure at which the effect is appreciable, determined for this case. J. P. A.

VISCOSITY, FRICTION AND LUBRICATION.

5189. Viscosity of Solutions, in Particular of Solutions of Substances of High Molecular Weight. E. Guth and H. Mark. *Ergeb. d. exakt. Naturwiss.* 12. *pp.* 115–162, 1933.—The facts at present known about the relationships between viscosity and concentration of a solution, and viscosity and size and shape of the particles in highly disperse colloid solutions are reviewed. The way in which the viscosity of solutions arises is discussed theoretically from hydrodynamical premises. The resistance opposed to the translational motion of a rigid body through a fluid is treated mathematically. Einstein's theory of the viscosity of solutions is described, and the theory is extended to ellipsoids. Kuhn's elementary calculation of the change of viscosity in consequence of elongated suspended particles is given, and the influence of the Brownian movement is discussed. In the concluding section the author gives a concise statement of the present position of our knowledge on the subject and compares the empirical laws so far obtained with the results which emerge from the theoretical treatment. H. L. B.

5190. Internal Friction of Liquid Systems of Limited Miscibility. M. Pestemer and M. Birkmann. *Kolloid Zeits.* 65. *pp.* 25–31, *Oct.*, 1933.—The interfacial friction in the ternary system benzene-alcohol-water is governed by the maximum values in the two-component binary systems ; the ternary maximum is at about 10 % alcohol, 55 % benzene, and 35 % water. In systems such as paraffin–water no maximum occurs ; addition of NaOH or HCl displaces the viscosity-composition curve in the direction of greater oil concentration. H. F. G.

5191. Anomalies in the Viscosity of Mineral Oils at Low Temperatures. Louis, Jordachescu and Thiebault. *Physics,* 4. *pp.* 401–402, *Nov.*, 1933.—Viscosity measurements at low temperatures show that after a temperature change an oil may require several weeks to attain an equilibrium state. Oils which show this viscosity anomaly are not truly viscous. The existence of a starting pressure called the yield value was not confirmed by experiment since the oil flows even under very slight pressure. AUTHORS.

5192. Viscosity of Vapours of Organic Compounds. T. Titani. *Chem. Soc. Japan, Bull.* 8. *pp.* 255–276, *Sept.*, 1933. *In English.*—An apparatus, based upon the principle of Trautz and Weizel, was constructed for measuring the viscosity of vapours. The viscosities of the vapours of air, n-pentane, n-hexane, hexamethylene, benzene, methyl acetate, ethyl acetate, ethyl ether, methyl alcohol, ethyl alcohol, n-propyl alcohol, iso-propyl alcohol, acetone, chloroform, carbon tetrachloride and carbon disulphide were measured at temperatures between 120° and 300° C. by means of the apparatus. The constants of both Sutherland and Reiganum and the collision diameters of the molecules were calculated from the results. F. J. B.

5193. Viscosity of Aqueous Solutions as a Function of Concentration. Part II. G. Jones and S. K. Talley. *Am. Chem. Soc., J.* 55. *pp.* 4124–4125, *Oct.*, 1933.—Earlier work on the viscosities of aqueous solutions was continued. The improved technique [see Abstract 1773 (1933)] was applied to the determination of the viscosities of aqueous solutions of KBr and KCl. The results indicated that the viscosity of solutions of KBr up to 2*N* could be calculated by the equation : $\eta = 1 + 0{\cdot}0074\sqrt{c} - 0{\cdot}04904c + 0{\cdot}01221c^2$, and of KCl by the equation : $\eta = 1 + 0{\cdot}0052\sqrt{c} - 0{\cdot}01612c + 0{\cdot}00808c^2$. F. J. B.

See also Abstract 5108.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

5194. Year 1900 as Standard Equinox (Second Paper). E. C. Bower. *Astron. J. No.* 998. *pp.* 46–48, *Sept.* 27, 1933.—The advantages of using 1900·0 as against 1950·0 for a standard equinox are pointed out especially from the point of view of saving computation and printing. [See Abstract 4854 (1932).] G. C. McV.

5195. Toronto University 74-inch Reflecting Telescope. *Nature,* 132. *pp.* 589-591, *Oct.* 14, 1933.—The driving circle has diameter, 8 ft., on whose bronze rim are cut 960 teeth of 8-mm. circular pitch ; the sidereal circle is also 8 ft. and is strung on the driving circle boss ; the declination axis is of forged steel, 13 ft. long, 3½ tons weight, mounted in ball radial bearings ; the declination circle drives two drums of 12-in. diameter geared up 72 : 1, with no backlash. The main mirror cell is a ribbed steel casting with 9 pad supports ; 18 weighted levers support the mirror laterally ; the iris diaphragm has range from 12 to 74 inches and is operated by a hand-wheel, the moving ends of the leaves being guided between parallel bars ; the skeleton portion of the tube is octagonal, and of 3-in. duralumin I beams, connected by steel gussett plates. Diagonal tension duralumin rods, screwed with right and left threads, are fitted in each bay and are always in tensions whatever the tube's position. The main mirror is of pyrex glass with 30-ft. focus ; the Cassegrain and Newtonian mirrors are of hard crown of 19-in. and 20-in. diameter. The total weight of the telescope is about 50 tons. The dome and buildings are described. A. S. D. M.

5196. Use of Hartmann Spectro-Comparator. J. Hartmann. *Zeits. f. Instrumentenk.* 53. *pp.* 443–446, Oct., 1933.—A critique of a paper by H. Nöbel on the use of this instrument for measuring radial velocities [see Abstract 137 (1933)]. The author points out certain errors in the exposition given and refers to the statement that the instrument is of a new pattern by Zeiss. J. W. T. W.

COMETS AND METEORS.

5197. Meteor Shower of 1933, October 9. E. Esclangon. *Comptes Rendus,* 197. *pp.* 801–804, *Oct.* 16, 1933.—This was the finest meteoric display seen since that of 1885, November 27, which was connected with Biela's comet. The shower of this year was not nearly so rich, but unlike the other the meteors differed greatly in brightness, and doubtless also in mass, some being barely visible in a clear sky, while others outshone Sirius. The maximum occurred at about 20 h. G.M.T., the number then being 15 per second, and the mean of the positions found for the radiant at different places in France is $\alpha = 266°\cdot 1$, $\delta = +55°\cdot 0$ Evidently the meteors belonged to the same swarm which gave rise to feeble showers on October 9 in 1920 and 1926, and were all connected with the comet Giacobini, which has a period of 6·58 years and an orbit which passes very near ours. It is unusual for such slow-moving meteors as these are to leave long bright trails, but this characteristic was noted in

1926 also, by Denning. In that year we met meteors which were ahead of the comet, in this year they were following. The greater display probably indicates either an increasing disintegration of the comet, or a passage of the earth through a denser part of the swarm. M. A. E.

See also Abstract 5199.

COSMOGONY.

See Abstracts 5178, 5219.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

5198. Problem of Two Bodies of Variable Mass. E. O. Lovett. *Comptes Rendus*, 197. *pp.* 674–676, *Oct.* 2, 1933.—The problem is that of two bodies of variable mass, attracting as power k of the distance, where the sum of the masses is given by power n of a linear function of the time. The author summarises known solutions ; writes the equations in a slightly more general form ; his changes of variable lead to linear equations ; the previously known solutions can be deduced. T. L. M.

5199. Calculation of Ephemerides in nearly Parabolic Orbits. J. P. Möller. *Roy Astron. Soc., M.N.* 93. *pp.* 777–788, *Oct.*, 1933. *Supplement.*—The transformation $\sigma = \sin (E/2)/\epsilon^{\frac{1}{2}}$ (Andoyer) is used ; but in place of successive approximations σ is expressed as a series in ascending powers of ϵ, and the coefficients, which are functions of tan $(v/2)$ and therefore of P, are tabulated against P. The method is convenient for calculating machines. T. L. M.

LATITUDE AND LONGITUDE.

5200. Simple Apparatus to Measure the Personal Equation in Instrumental Observations of Constant Altitudes. E. Buchar. *Bull. géodésique*, 38. *pp.* 167–172, *April–May–June*, 1933.—The principle of the method employed consists in observing the coincidence of the observed star with an artificial star whose apparent height and brightness can be varied. A series of measurements extending over a year are summarised and the effects on the personal equation of the size, brightness and rate of travel are found. It is shown that the error is less for a bright slow travelling star than for a faint rapidly travelling one. The author gives an equation in the form $P = 0{\cdot}08 - (0{\cdot}011 + 0{\cdot}0010\, m)\, dH/dt$ where P is the personal equation in seconds, m indicates the size of the star and dH/dt its rate of travel. R. S. R.

PLANETS.

5201. Spectrographic Studies of the Planets. V. M. Slipher. *Roy. Astron. Soc., M.N.* 93. *pp.* 657–668, *Oct.*, 1933. *Supplement.*—A general account is given of the methods of spectrographic study of the planets, especially as carried out at the Lowell Observatory. The planets fall into two main groups : those which show little or earth-like atmospheric bands and those which show strong selective absorptions. The first group contains Mercury, Venus, Mars, Pluto and the Earth ; the latter, the four giant planets. The absorption of the atmospheres of the giant planets apparently persists deep into the heat spectrum. If the atmospheres of these planets obstruct the spectrum range which our atmosphere transmits and vice versa, the temperatures of the major planets will be far higher than radiometric measures suggest. G. C. McV.

5202. Stability of Saturn's Rings. C. G. Pendse. *Phil. Mag.* 16. *pp.* 575–580, *Sept.*, 1933.—Maxwell investigated the stability of the motion of a rigid plane ring about a central homogeneous sphere in a plane passing through the centre of the sphere, and he deduced the instability of the motion of any conceivable rigid circular ring by considering the particular cases of the general results obtained on the assumption that the law of universal gravitation is applicable to the Saturnian system. He deduced, as a particular case, the instability of the motion of a uniform rigid circular ring. The author shows that the general equations become meaningless in the case of the steady motion of a uniform circular ring; the instability can, however, be proved by a slightly different method. H. L. B.

5203. Rotation Period of Saturn. B. M. Peek. *Observatory*, 56. *pp.* 308–311, *Oct.*, 1933.—The recent appearance of a remarkable white spot in the equatorial zone of Saturn has provided another opportunity for determining the planet's period of rotation. The results of determinations of the period of rotation made on the occasions of previous appearances of surface markings are revised. It seems probable that the surface of Saturn revolves more rapidly in its equatorial regions than in higher latitudes. J. E. K.

STARS.

5204. Standard Photometric and Visual Magnitude Scales. R. H. Tucker. *Am. Phil. Soc., Proc.* 72. 5. *pp.* 351–354, 1933.—The San Luis Catalogue (15,333 Southern Stars) magnitudes are mostly from the Harvard College Observatory Photometric measures; Boss's Preliminary General Catalogue (6188 stars over all the sky) magnitudes are from Chandler's stellar estimates. Two tables of differences are given: the San Luis has (1) estimates brighter than the 1st mag., (2) between 1st and 2nd mags., (3) down to the 8th mag. and under; Boss's P.G.C. has similar estimates. The two scales are in agreement at grade 4½ where the differences are close to zero and the numbers are nearly 400 each. Graphically the plot of mean differences follows closely a straight inclined line from groups of bright stars fully to the 7th mag.; below this the comparisons show scatter. Nearly all stars down to the 5th mag. are shown on the southern sky. The deduced light ratio of the P.G.C. is close to 2·0 and of the San Luis is 2·2. The light ratio of the photometric scale is thus about 0·2 greater than that of the historic visual scale down to the 7th magnitude. A. S. D. M.

5205. Distribution of Absolute Magnitudes among Stars of Spectral Types A, F, G, and K as Determined from Trigonometric Parallaxes. G. Strömberg. *Mt. Wilson Observat. Contrib. No.* 473. *Astrophys. J.* 78. *pp.* 178–188, *Oct.*, 1933.—The distribution of absolute magnitudes of stars of spectral types A, F, G, and K has been determined from the trigonometric parallaxes. Only stars brighter than apparent magnitude 5·5 have been used. For each spectral class the stars were divided into two groups, brighter and fainter than magnitude 4·5. The method consists in solving the integral equation involving the distribution of parallaxes and accidental errors both multiplied by the factor $10^{0\cdot 2m}$.

The results are in good agreement with those found by a similar method from the distributions of parallactic and peculiar motions and radial velocities and published in *Mount Wilson Contribution* No. 442. [See Abstract 2787 (1932).] AUTHOR.

5206. Systematic Errors in Trigonometric Parallaxes as a Function of Right Ascension. A. van Maanen. *Mt. Wilson Observat. Contrib. No.* 474. *Astrophys. J.* 78. *pp.* 189–199, *Oct.*, 1933.—From a comparison of the trigonometric parallaxes derived at the Mount Wilson, Allegheny, McCormick, Yerkes, Sproul, Greenwich, Johannesburg, and Cape of Good Hope Observatories with the recently determined system of Mount Wilson spectroscopic parallaxes, it was found that all eight series are affected by systematic errors which are a function of right ascension. The corrections derived are given. The application of these corrections produces a marked improvement in the agreement between the different series *inter se*. AUTHOR.

5207. Spectroscopic Determinations of Parallax. A. Kohlschütter. *Ergeb. d. exakt. Naturwiss.* 12. *pp.* 1–35, 1933.—A comprehensive survey of the various methods of measuring the distances of stars. Defines the problem and gives an account of the various parallax methods based on: trigonometry, magnitude of stars, statistical mean, deductions from motions of stellar systems, observations of orbits in the case of double stars, and position of the " isolated " Ca$^+$-line. The author then gives a detailed account of the spectroscopic methods of determining parallax, in particular, as applied at the Mount Wilson Observatory. The extension of the method to B- and A-stars is described. A summary is given of the work in this connection at other observatories, namely, Harvard, Norman Lockyer, Victoria (Brit. Columbia), Arcetri (in France) and Yerkes. The author adds remarks on spectrophotometric methods and on the bearing of parallax determinations on other astronomical problems. H. L. B.

5208. Effect of Errors of Observation on the Spectroscopic Determination of Stellar Rotation. J. A. Carroll. *Roy. Astron. Soc., M.N.* 93. *pp.* 680–690, *Oct.*, 1933. *Supplement.*—The effect of accidental and systematic errors of observation in stellar-line profiles is discussed in connection with the method of testing for and determining stellar rotation already described [see Abstract 3974 (1933)]. It is found that the method is independent of distortions of the observed profile due to scattered light and to finite resolving power of the spectrograph employed, in the sense that no numerical corrections to the results are required, though if insufficient resolution be employed the method will fail to yield results owing to the impossibility of identifying the rotational zeros. A mode of assessing the effect of " accidental " errors is developed, and it is found that special care is necessary in averaging the rotational speeds obtained from different zeros, and in the interpretation of deviations from the mean. It is shown how these difficulties may be avoided. An estimate is given of the accuracy needed for this process, and the experimental procedure necessary to provide it. AUTHOR.

5209. Motions of A-Type Stars. C. Bertaud. *Comptes Rendus,* 197. *pp.* 905–906, *Oct.* 23, 1933.—Space velocities with reference to the sun have been computed for 523 stars between Ao and Fo, preference being given to spectroscopic methods for the more distant, and Raymond's correction to the P.G.C. μ_δ being applied. There are shown streams in

Taurus (41 A-stars) and in Ursa Major (75 A-stars). The A-stars have a feeble mean velocity of the order of Cepheid motion, and the streams affect the latitude of the apex and the magnitude of the velocity only, these being altered to a small degree. A table is given of the velocity ellipsoids for the stars (including and excluding the streams); both the major and mean axes are in the galactic plane, the minor axis being almost perpendicular to it. Excluding the streams, the velocity ellipsoid is sensibly one of revolution round the major axis. For all the stars the proportion of the number of velocities directed along the axes is 55·4 : 6·4 : 3·4 and without the streams, 31·1 : 7·8 : 4·0. A. S. D. M.

5210. Red Titanium Oxide System in α_1 Herculis. N. T. Bobrovnikoff. *Astrophys. J.* 78. *pp.* 211–218, *Oct.*, 1933.—Sixty-six bands belonging to the red system of TiO have been measured in the spectrum of α_1 Herculis between λ 6292 and λ 8506. Of these, eleven bands of the sequence − 2 have never been observed in the laboratory. The Q-heads in the star seem to be much fainter than in the laboratory sources. In addition to the bands in the red system, four bands belonging to the blue-green system of TiO and two unclassified bands of TiO have been found in the same spectral region in this star. AUTHOR.

5211. Variations in the Spectrum of 42 Camelopardalis. D. L. Edwards. *Roy. Astron. Soc., M.N.* 93. *pp.* 729–735, *Oct.*, 1933. *Supplement.*—Short-period variables of the β Canis Majoris type are frequently found to show variations in intensity of the spectral lines of a kind suitable for investigation with the equipment available at Sidmouth. The star 42 Camelopardalis was photographed at regular intervals to ascertain if it belonged to this group of variables, and if so the nature of the spectrum changes which occur. Definite intensity changes were found for the lines at λλ 4388, 4144, 4481, 4128–31, 4267, and (to a lesser extent) 4121, 4009. These were measured with a photometric wedge and are described in detail. The period was found to be $0^d.1385$, with some evidence suggesting a possible variation. The rise to a maximum in the curve of intensities is very rapid, requiring only $0^d.043$, while the fall back to a minimum takes $0^d.095$. The shape of the curve thus bears some resemblance to the light curves of Cepheid variables. AUTHOR.

5212. Opacity Formulæ and Stellar Line Intensities. H. N. Russell. *Mt. Wilson Observat. Contrib. No.* 477. *Astrophys. J.* 78. *pp.* 239–297, *Nov.*, 1933.—General opacity equations are derived for the numbers of neutral and ionised atoms and the optical depth in an atmosphere containing two partially ionised elements and others not ionised. Solutions in which only one component is supposed to be partially ionised—the rest being completely ionised or completely neutral—suffice in almost all practical cases. The influence of variations in abundance, gravity, and temperature are discussed. The conditions that the lines of an element should have a maximum with varying temperature are discussed, where opacity is due to interaction either of electrons and ions or of neutral atoms and electrons. Conditions for maxima of H, Mg^+, and Fe^+ lines in stellar atmospheres are derived and compared with the solar atmosphere; the maxima of Fe^+ and Ti^+ show H from 1000 to 2000 times more abundant than all metals together. Such a model atmosphere is discussed and line intensities computed. The resulting temperatures of maximum agree closely with observation, including the anomalous K line; while a number of anomalies discussed includes distortion of the energy-curve in class A stars, absolute-magnitude effect for H and He at high temperatures, strength of the Balmer series, and enhanced lines in red giant stars. T. L. M.

5213. Stellar Atmospheres. L. Biermann. *Göttingen Nachrichten, Math.-Phys. Klasse, No.* 3. *pp.* 297–315 *and* 350–358, 1933.—Three problems are discussed: (1) The dependence of absorption coefficient on wave-length is treated from the point of view of the electron transitions which produce the continuous spectrum. An ideal atmosphere is set up and the resulting absorption edges taken into account. The reality of the results is verified by comparison of measured intensity distribution of a type A star relative to a type G star. (2) The opacity is defined and computed for the reversing layer of the Sun. An attempt is made to estimate it for an A type star with results in satisfactory agreement. (3) Stellar temperatures derived from different spectral regions for early type stars show widely differing temperature scales; the author discusses the assumptions involved and concludes that unless the coefficients of continuous absorption for the region are known, the true effective temperature cannot be found. T. L. M.

5214. Dissociation of Molecules in Atmospheres of Stars in Main Sequence. Yvonne Cambresier and L. Rosenfeld. *Roy. Astron. Soc., M.N.* 93. *pp.* 710–723, *Oct.*, 1933. *Supplement.*—Typical intensity variations of molecular bands in stellar spectra depend on variation of the number of molecules in the star's reversing layer. Temperature variations have been discussed in previous treatments; the method of Milne and Chandrasekhar for computing pressure from general absorption leads to the possibility of introducing pressure variations. The method, introduced in the ionisation equilibrium problem, is transferred by the authors to the dissociative equilibrium problem. They discuss the chemical reactions to be taken into account, limiting themselves to the combinations of abundant elements (treated as H, O and N), with less abundant elements (C, Ti, Zr); they discuss the formation of TiO and ZrO and the equilibrium of CH, CO, CN and C_2. The main features of molecular band intensities along the main sequence are accounted for with a similar chemical composition of the atmosphere. [See following Abstract.] T. L. M.

5215. Dissociation of Molecules in Atmospheres of Carbon Stars. L. Rosenfeld. *Roy. Astron. Soc., M.N.* 93. *pp.* 724–729, *Oct.*, 1933. *Supplement.*—The idealised stellar atmosphere employed in a previous paper [see preceding Abstract] cannot be applied to the carbon (R,N) stars. It is assumed that the latter must differ in the relative abundance of carbon and oxygen from the main sequence. Oxygen is no longer treated as an abundant element; the resulting theory is compared with observation (principally by Shane); the author concludes that the observed intensity variations of the molecular bands are accounted for in general terms on the theory of dissociative equilibrium by assuming a uniform idealised chemical composition of the atmosphere for all carbon stars, differing only from that assumed for main sequence stars in the relative scarcity of O with respect to C. T. L. M.

5216. Equilibrium Theory of Abundance of Elements: Statistical Investigation of Assemblies in Equilibrium in which Transmutations Occur. T. E. Sterne. *Roy. Astron. Soc., M.N.* 93. *pp.* 736–767, *Oct.*, 1933. *Supplement.*—If stellar radiation is maintained by

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subatomic energy, the most probable source is energy liberated during transmutation of elements; the author discards the " annihilation " theory. The problem is therefore one of statistical mechanics, applicable in so far as the interior of the stars are nearly insulated assemblies, and is defined: What will be the abundances of the nuclei of the various elements in an assembly in statistical equilibrium at defined temperature—an assembly containing radiation, electrons, protons, neutrons, and atomic nuclei which are undergoing all sorts of transmutations without any " annihilation " ? Two cases are considered: (*a*) electrons and protons (al. neutrons and electrons) as ultimate particles; (*b*) electrons, protons, and neutrons independent ultimate particles. In (*a*) there are three independent parameters; in (*b*) four. The statistical theory is fully developed and an application to an artificial case of variation of composition with temperature given. Some astrophysical inferences are made. [See following Abstract.] T. L. M.

5217. Liberation of Energy by Transmutations of Nuclei in Stars. T. E. Sterne. *Roy. Astron. Soc., M.N.* **93.** *pp.* 767–769, *Oct.*, 1933. *Supplement.*—In an assembly in equilibrium in which all possible transmutations of nuclei occur, energy is liberated if it cools at constant volume at a rate so slow that equilibria are nearly perfectly established at any time. The equations are given for case (*a*) of the previous paper. [See preceding Abstract.] The case of slow compression at constant temperature is also considered. [See also following Abstract.] T. L. M.

5218. Equilibrium of Transmutations in Stars in which Transmutations are an Important Source of Energy. T. E. Sterne. *Roy. Astron. Soc., M.N.* **93.** *pp.* 770–777, *Oct.*, 1933. *Supplement.*—If transmutations contribute appreciably to stellar radiation, the contribution must come from the disappearance of H or of neutrons. If the reverse process does not occur at nearly the same speed, the star is likely to become overstable; the energy must therefore be liberated more rapidly than radiated and the excess energy absorbed in reverse processes; and transmutations must be in approximate equilibrium. The difficulties involved in assuming a non-equilibrium state are illustrated by the capture of protons by Lithium nuclei. The author is inclined to conclude that transmutations, if an important source of stellar energy, must be in equilibrium; this involves temperatures of 10^9 °K, or more. [See preceding Abstract.] T. L. M.

5219. Statistical and Dynamical Aspects of the Fission Theory. W. Markowitz. *Astrophys. J.* **78.** *pp.* 161–177, *Oct.*, 1933.—I. Statistical. —The assumption that widely separated eclipsing binaries have been formed from close pairs by the process of contraction requires that the initial densities of the present wide pairs were systematically lower than those of the present close pairs. The questions of a reduction in the mass of binary stars, and of the effect of the limited time scale introduced by the idea of an expanding universe, are discussed. Present indications are that the stars are not picking up enough interstellar matter to balance the loss of mass by radiation, but the subject is considered an open one. II. Dynamical.—Application of the formula $\rho < C/P^2$, where P is the period of a binary formed by fission, C is a known function of its mass ratio, and ρ is the density of the " liquid core " of the parent star, to the β Lyrae variable W Crucis and to Capella shows that the densities of the cores of their parent-stars were of the order of 10^{-6} gm./cm^3. The implication is that they were gaseous and not liquid. A gaseous star is not subject to fission if the ratio of its central density to the mean is greater than 2·7, and this ratio is exceeded in most of the stellar models heretofore presented. The law of internal density of a model by Rosseland is such that it might become either lens-shaped or ellipsoidal upon contracting. If it becomes lens-shaped, then an immediate increase in the mean density of at least 40 must occur during disruption, if a binary of mass-ratio unity is to result. AUTHOR.

5220. Galactic Rotation Effect on Radial Velocities of Late Type Stars. H. Nordström. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 14. *pp*. 1–33, 1933. *In English.*—Attempts to deduce the longitude of the galactic centre from radial velocities of K, M stars have usually yielded values differing considerably in a positive direction from the geometrical centre. The author rediscusses the older material, giving in particular a solution for bright stars which considerably reduces the discrepancy. He then rediscusses the velocities measured by Redman. He divides the material into overlapping zones 40° wide. Within each zone he divides the velocities into classes of breadth 5 km./sec. The resulting velocity distribution curves are smoothed. The mode is derived in place of the arithmetic mean, thus eliminating local streams and other irregularities. The values of the mode for the different regions show the second harmonic strongly; the resulting longitude differs very little from the geometrical centre; the use of the mode is justified by the author. T. L. M.

5221. Theory of Rotation of the Galaxy. B. Lindblad. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23*A*. 18. *pp*. 1–12, 1933. *In English.*—The general transformations of the frequency function in a rotating stellar system are considered. The importance of accidental condensations of low internal velocity dispersion which grow out of and dissolve into the general stratum of the stellar system is pointed out, and it is shown that such condensations will in general have a tendency to shift the frequency maximum to lie near the circular orbits in the plane of rotation. Further, if the sun is at present not far from such a semi-permanent, now practically dissolved condensation, the low velocity dispersion of the stars compared with the velocity of rotation will be explained. The effect of slow statistical connection between states of motion which are theoretically in communication with one another is considered, and application is made to the frequency function of the motion at right angles to the galactic plane. AUTHOR.

5222. Two Variable Stars with Double Periods, AI Scorpii and SX Centauri. D. J. K. O'Connell. *Harvard Coll. Obs., Bull. No*. 893. *pp*. 14–21, *Oct*. 1, 1933.—For AI Scorpii, 1037 estimates (by Gerasimovič and the author), and for SX Centauri 915 estimates were determined by comparison with Harvard Standard Regions. In both cases the maxima and minima fluctuate in height apart from long-period variation: for AI Scorpii the mean short period is $35^{d}.62$ (the fluctuation being between $35^{d}.1$ and $36^{d}.1$); for SX Centauri the mean is $16^{d}.46$ (the fluctuation being $16^{d}.41$ and $16^{d}.49$); the two long periods for these stars are 980^{d} and 600^{d} respectively. Diagrams are given for the two variables. Up to the present 12 variables are known to have both long and short periods and for 9 of these (SX Centauri, V Sagittae, SU Geminorum, AI Scorpii, DF Cygni, UZ Persei, TW Pegasi, W Orionis and V Hydrae) the periods have been determined and are listed in order of length of period giving the short period (*p*), long period (P), spectrum and galactic latitude. A diagram shows these two periods plotted against each other, and all, except AI Scorpii, lie close to a smooth curve, which in this case appears closely hyperbolic (but as there are only 9 points little weight can be given to the form). The suggested correlation is important as pointing to an intimate connection between the cause of variability in such widely different stars as the Cepheid-like variables of the AI Scorpii type, and the Long-Period N stars like W Orionis and V Hydrae. The author suggests searching for double periods among the irregular Cepheids and the N-type variables. A. S. D. M.

5223. Orbit of E2294. R. H. Wilson. *Astron. J. No.* 998. *pp.* 41–46, *Sept.* 27, 1933.—The computation of the orbit of this double star is carried out by the Thiele-Innes method and the ephemeris is given. G. C. McV.

5224. System of HD 198287–8. W. H. Christie. *Mt. Wilson Observat. Contrib. No.* 475. *Astrophys. J.* 78. *pp.* 200–210, *Oct.*, 1933.—The discovery of bright hydrogen lines in the spectrum of HD 198287–8 in 1921, by Merrill, Humason, and Miss Burwell, led to this investigation of the star. A number of variations in the physical characteristics have been found, on which a preliminary report is given. The star is variable in velocity with a short period of 18·60 days, while the velocity of the system as a whole varies with a period of about 12·3 years. The amplitude of the short-period velocity-curve varies with a period comparable with that of the long-period velocity variation. There are two outstanding variations in the spectrum: one in the character and strength of Hβ, the other in the intensity of an unidentified line near λ 4232. Hβ consists of a double-emission line, the two components of which vary in both relative and absolute intensity with a period identical with that of the short-period velocity change. λ 4232 appears strong at only one phase; most of the time it is either invisible or else so weak that its identification becomes doubtful. The star varies in brightness with a period apparently identical with the short-period velocity variation. The light-curve is similar to that of β Lyrae. AUTHOR.

5225. Triple System of 13 Ceti. W. J. Luyten. *Astrophys. J.* 78. *pp.* 225–238, *Nov.*, 1933.—The system of 13 Ceti, in which three components are now known with certainty, has always presented unusual difficulties in observation and interpretation. Several orbits, visual as well as spectroscopic, have been derived—none as yet entirely satisfactory—and many suggestions have been made concerning various possible sources of perturbation. It is shown in the present paper that the orbit derived by Maggini from a large number of interferometer measures does not obey the law of areas, and from a rediscussion of the entire material a new visual orbit is derived which accords closely with Aitken's original one. The various suggestions and explanations offered for the observed perturbations are discussed, and it is shown that most of these are quantitatively unreasonable, while furthermore it appears that in most cases the perturbations were a direct result of the use of too many uncertain decimals. The spectroscopic orbit is derived anew from all the available material and it is found to possess a definite, though small, eccentricity, while furthermore a large advance of periastron appears to be indicated. This is tentatively explained as due to the precession operating in the spectroscopic system owing to the large tidal deformation of the two components. Finally, by making plausible assumptions concerning the orbital planes, values are derived for the absolute dimensions of the spectroscopic system and for the individual masses of the three components now known. AUTHOR.

See also Abstracts 5196, 5226, 5317.

SUN.

5226. Calcium Ionisation Temperature of the Sun. R. v.d. R. Woolley. *Roy. Astron. Soc., M.N.* 93. *pp.* 691–710, *Oct.*, 1933. *Supplement.*—The author develops a method for determining a precise value of the solar temperature from observations of the equivalent breadth of Ca and Ca^+ lines. Using Chandrasekhar's absorption coefficient, the electron pressure can be calculated at any given depth. The ratio of ionised to neutral calcium atoms per c.c. at this depth is also found, from the equivalent breadths of the principal Ca and Ca^+ lines (4227, 3933), with the help of a factor which is computed. From these quantities the temperature at the level is calculated from Saha's formula, suitably modified. Cambridge observations lead to a value of $T_e = 6310 \pm 50$ for sunlight integrated over the disc. Sources of error are discussed; results by other methods are compared. The observations are used also to calculate the absorption coefficients of some neutral Ca lines; some account of the new quantum theory of the widths of absorption lines is given. The above method is also applied to Hogg's measurements of the same lines in K and M stars; the resulting stellar temperatures are higher than usually given. T. L. M.

See also Abstracts 5212, 5238, 5294.

ZODIACAL LIGHT AND GEGENSCHEIN.

See Abstract 5232.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

5227. Influence of Absorbed Water on Electrical Conductivity of Rocks. (Mrs.) F. Bayard-Duclaux. *Comptes Rendus*, 197. *pp.* 854–856, *Oct.* 16, 1933.—The author's method (see *ibid.*, 196. *p.* 1331, 1933) has been used to examine the conductivity of 14 varieties of rocks. The samples were cut from specimens that had been kept in a glass case for several months (*a*) as cut, and (*b*) after drying for 3 days at 190° (resulting in the loss of 0·02 to 1·5 % H_2O). Those of type (*a*) showed conductivities of from 5×10^{-11} mho (obsidian) to $2 \cdot 5 \times 10^{-6}$ (schist); (*b*) were all non-conducting (*i.e.*, less than 8×10^{-12} mho). The conductivity/time curves for the dried rocks when exposed to the atmosphere indicated that at first absorbed water combines without forming mobile ions; these are later produced as more water is absorbed, causing electrolytic conductivity; thus showing that conductivity is not a surface phenomenon. C. A. S.

See also Abstracts 5240, 5454.

HYDROSPHERE, PHYSICS OF THE.

5228. Problem of Tidal Theory. O. Pettersson. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 23*A*. 23. *pp.* 1–9, 1933.—The author states discordances between theory and observation, especially as regards Scandinavian waters, and proposes to account for them by effects of vertical tidal force, which, though ineffective as to surface effect, would cause an internal tide within the ocean, especially at an equipotential surface constituting an oceanic tropopause. T. L. M.

LAND, PHYSICS OF THE.

5229. Continuous Generation of Heat in Certain Silicates. E. A. Harrington. *Am. Phil. Soc., Proc.* 72. 5. *pp.* 333–349, 1933.—The existence of a continuous generation of heat in certain silicates has been investigated by putting the material in a well-insulated calorimeter supported in a jacket maintained at 0° C. Temperature differences between calorimeter and jacket were observed by a thermoelement connected directly to a sensitive galvanometer. For a few materials a positive result was indicated. Some consequences of such a result have been examined. AUTHOR.

5230. Cooling of a Radioactive Sphere. A. N. Lowan. *Phys. Rev.* 44. *pp.* 769–775, *Nov.* 1, 1933.—By means of the Laplace transformation, any physical problem characterised by a partial differential equation, the solution of which must satisfy prescribed initial and boundary conditions, can formally be transformed into a boundary problem for an ordinary differential equation. From the solution of the latter problem, that of the original problem may be obtained by the inversion of the Laplace transformation. The method is applied to the problem of the cooling of a radioactive sphere and the solution of this problem is applied to a discussion of the thermal history of the earth. AUTHOR.

See also Abstracts 5227, 5240, 5454.

METEOROLOGY.

5231. Continuous Photoelectric Registration of Polar Auroræ. A. Dauvillier. *Comptes Rendus*, 197. *pp.* 780–781, *Oct.* 9, 1933.—Information is given relating to the construction and use of the apparatus. It has been in use at Scoresby Sund during the Polar Year to obtain measurements of the polar auroræ. It can be used to obtain registrations of invisible auroræ at full moon, dawn and sunset, when the green ray (5577 Å) is masked by the continuous solar spectrum. In cloudy or foggy weather the aurora is shown as an indentation on the continuous curve. Complete auroral statistics are thus possible. The brightness of the auroral phenomena varies from 1 to 10^4 in the period of minimum solar activity and no geophysical phenomenon can vary in such a way. The diurnal variation of the aurora can be obtained and compared with the magnetic curves. In auroral storms the great speed of evolution is shown. It is hoped to extend the procedure to give permanent registrations all over the earth. R. S. R.

5232. Auroral Spectrograph and the Upper Atmosphere. L. Vegard. *Nature*, 132. *p.* 682, *Oct.* 28, 1933.—The results of investigations on the auroral spectrum carried out by the author and collaborators are discussed. The spectrum has been explored between the limit in the ultra-violet and to about 9000 Å in the infra-red and 85 lines and bands have been recorded photographically and measured. He finds (1) apart from the green line the spectrum of an ordinary aurora is dominated by negative and positive nitrogen bands; (2) all the 8 infra-red bands as yet observed and many of the red bands belong to the first positive group of nitrogen; (3) the second green line or band has a wave-length of about 5240 Å and cannot be identified with oxygen lines or with bands of the negative nitrogen group; it may be referred to the first positive group of nitrogen or the band N_2 of solid nitrogen; (4) in the ultra-violet a diffuse band series coincides with one from solid nitrogen; (5) in the red part two lines 6302 and 6365 appear which may be identical with the O_1 lines $({}^1D_2 - {}^3P_2)$ and $({}^1D_2 - {}^3P_1)$ respectively, but no O_1 lines are found in the infra-red and it is doubtful whether O_1 lines other than those attached to the levels ${}^1S_0$, ${}^1D_2$, and ${}^3P_{012}$ appear in the auroral spectrum, reasons for which are given; and (6) lines of hydrogen and helium are either not present or are extremely weak. The average energy of the more prominent bands and lines has been measured. The intensity distribution is subject to considerable changes with auroral type and enhancement with solar cycle changes and with increase of altitude. It is considered that a terrestrial corona exists resembling the solar corona which can account for the increased height of auroral rays in lower latitudes and near sunset, and for the zodiacal light. R. S. R.

5233. Dynamical Pressure Effect on the Friez-Type Aerometeorograph. L. P. Harrison. *Monthly Weather Rev.* 61. *pp.* 140–141, *May*, 1933.—One of the sources of error in the reading of an aerometeorograph mounted on an aeroplane in motion arises from the relative motion of air and object, giving an excess on the windward and a deficiency on the leeward side of the object. The present paper indicates how this error may be allowed for by use of data obtained with the aerometeorograph from wind tunnel measurements. These observations show a pressure defect from the static value and that this pressure defect, Δp, is proportional to $1/2\, \rho v^2$, (ρ = the density, v = velocity of the air) or that $\Delta p = kv,^2$ where k is a constant depending on the angle of yaw. A table giving k for different angles of yaw is compiled, thus enabling the true pressure to be found from the observed. Attempts were made to reduce the pressure errors by introducing flaps over the side holes in the instrument. Photographic illustrations of the instrument are given with cover off and with cover on. A. E. M. G.

5234. Hygrometer for Use in Small Spaces. K. Mellanby. *Journ. Sci. Instruments*, 10. *pp.* 349–351, *Nov.* 1933.—A method is described by which the humidity of the air in very small spaces can be measured. Paper is a hygroscopic substance which absorbs an amount of water from the air proportional to the relative humidity. Using a torsion balance it is possible to measure the change in weight of a piece of paper which weighs about 10 mg. with sufficient accuracy to measure the relative humidity of the air to 2 %. AUTHOR.

See also Abstract 5238.

SEISMOLOGY.

5235. Smoothed Time-Distance Tables for a Normal Focus Earthquake. S. Gold, with foreword by E. A. Hodgson. *Dominion Observat., Ottawa, Pamphlet M.*7. *Received Oct.* 31, 1933.

5236. Travel Time of Earthquakes. Parts III and IV. K. Wadati and S. Oki. *Geophys. Mag., Tokyo,* 7. *pp.* 113–153, *Aug.*, 1933. *In English.*—The author has sought to obtain the most accurate values of the travel time curves of seismic waves especially for large epicentral distances. He considers it best to use earthquakes of shallow focus whose epicentral depth is known accurately. Three large Japanese earthquakes are consequently considered. The position of the epicentre and the depth and time of occurrence at the focus for each are obtained and the travel time curves for P and S waves are found for epicentral distances up to 100°. From three large earthquakes of shallow focus the Japanese mean travel time curve of P was found. The P curve for an earthquake at 400 km. focal depth was found and its reduced curve agreed closely with that for the shallow earthquakes. For the S curves only the deep focus earthquake could be used. The P and S curves agree well with Jeffrey's curves. It was found that extraordinarily large earthquakes occur near the earth's surface or at a depth of several hundred km. The velocity of propagation of P and S waves was calculated from the author's travel time curves by the Herglotz-Wiechert method and the values found agree well with former results but especially those of Witte. Remarkable discontinuities in the earth's crust were not found but rapid changes of velocity for P waves were found at 800 and 1400 km. and for S waves at 900 and 2200 km. P waves were found generally to follow a deeper path than S waves. Poisson's ratio is almost constant in the earth's crust but increases slowly with depth. [For Parts I and II, see Abstract 3451 (1933).] R. S. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

5237. Ball Lightning. J. C. Jensen. *Physics,* 4. *pp.* 372–374, *Oct.*, 1933.—The size, appearance and physical properties of ball lightning has been subject to much controversy and but few accurate data are available. Description is given of a series of five photographs showing luminous masses which were of unusual size and which remained visible in changing form for about 3 minutes. Suggestions for further investigations are given. AUTHOR.

5238. Terrestrial Reactions to Variations of Solar Activity. A. Nodon. *Comptes Rendus*, 197. *pp.* 907–908, *Oct.* 23, 1933.—Observations have shown that the sun may exert marked influence on such terrestrial phenomena as magnetic, electrical and atmospheric changes at times when no important sunspot or facula is visible. The author quotes a case in 1933 which showed on June 13th by effects on the magnetograph, electrometer, earth current, electrical oscillations in the aerial, and electromagnetic waves. The effects became steadily more intense in S.E. France until the 16th, and ceased only on the 27th. The effects were only slight 27 and 54 days later, but with the third solar revolution the disturbances were much amplified from September 3rd to 6th, and then decreased. It is suggested that a more complete study of the active regions of the sun is necessary. R. S. R.

5239. Classification of Magnetic Disturbances. (Mme.) Y. Labrouste. *Comptes Rendus*, 197. *pp.* 653–655, *Sept.* 25, 1933.—Different ways of characterising disturbed days are mentioned, and it is suggested that the length of the curves recorded would, if measured by a curvimeter, furnish a rapid means of classification, whilst periodic variations would be eliminated. In illustration, graphs are given from records taken at Val Joyeux which show maxima of disturbance with a 27-hr. period. Further, certain maxima occur at times when no solar spot is visible. G. E. A.

5240. Registration of Earth Currents with Neutral Electrodes. S. K. Banerji. *India Meteorolog. Dept., Mem.* 26. 1. [11 *pp.*], 1933.—The paper describes certain experiments made at the Colaba and Alibag Observatories during 1928–30 in regard to the registration of earth currents with short lines, about 250 metres long. The polarisation difficulties were overcome by making the electrodes neutral with respect to the soil, each electrode being a combination of electro-positive and electro-negative metals, the actual composition being found by trial and varying with the soil. The neutrality is not maintained indefinitely, and to avoid frequent removal and scraping of the electrodes, small separate electrodes of the positive and negative metals are sunk, and one or other of these is joined to the main as and when found necessary to correct for any small polarisation current that may develop. Such installations were set up at Colaba and Alibag, which are 5 and 25 miles respectively from the centre of the Bombay electric tramway network. Photographic records of earth currents show the leakage from this network; the oscillations are in excellent agreement with the voltage record at the power station. The range of the oscillations of the leakage current is about 110 micro-amperes at Colaba and only 5 at Alibag; the reduction in range agrees roughly with that corresponding to laminar flow. The disturbance produced in the magnetic registers agrees with the oscillatory magnetic force which such plane current sheets will produce. Besides the leakage currents, the earth current records show the natural diurnal current variation, and disturbance currents during magnetic storms. AUTHOR.

See also Abstracts 5231, 5232.

RADIOACTIVITY.

5241. Exponential Law of Radioactive Disintegration. A. E. Ruark. *Phys. Rev.* 44. *pp.* 654–656, *Oct.* 15, 1933.—The decay law, $N = N_0 e^{-\lambda t}$, is based on the assumption that the probability w of an atom disintegrating in unit time is constant. The question arises whether this assumption is necessary. It might happen that atoms of different ages have different decay probabilities; and w might depend on age in such a way that exponential decay curves would result. A theorem of Wolfke, however, can be interpreted in such a manner as to show that w cannot depend on the age of the atom. This result is generalised. Consider a series whose members A, B, etc., have decay probabilities, w_A, w_B, etc. If all members decay exponentially, if all w's are smooth and continuous functions of their variables and if each w is, at most, a function of the age of the atom, the ages of its ancestors and the ages of its descendants, then the w's are constant; and so in this more general case, the assumption of constant decay probability which underlies the wave mechanical theory of disintegration is necessary as well as sufficient. AUTHOR.

5242. Half-Life of Actino-Uranium and Geologic Time. F. Western and A. E. Ruark. *Phys. Rev.* 44. *pp.* 675–681, *Oct.* 15, 1933.—Assuming U^{235} to be the only long-lived uranium isotope its decay constant, λ_4, and that, λ_1, of U^{238} (both $\times 10^9$), and their half-lives ($\times 10^{-8}$) as deduced by averaging results from Karlshus bröggerite and Wilberforce uraninite are respectively (with branching ratio 0·03) 2·28 and 0·1514 per yr., and 3·10 and 45·8 yr.; or (branching ratio 0·04) 1·79 and 0·1509 per yr., and 3·96 and 46·0 yr., the values with branching ratio 0·03 are deemed more reliable, but for either value the ages of the bröggerite and uraninite would be respectively 0·81 and $1·04 \times 10^9$ yr. The effects of possible leaching are discussed, and that of uniform leaching worked out for the case of Katanga pitchblende. C. A. S.

5243. Beryllium and Helium. Part I. Helium in Beryls of Varied Geological Age. (Lord) Rayleigh. *Roy. Soc., Proc.* 142. *pp.* 370–381, *Nov.* 1, 1933.—The helium content of upwards of 60 specimens of beryl of varying geological age is determined, 1 gm. of the material being used in each case. In the following table are given the largest and median quantities found for the various groups (mm³. per gm. of beryl):

	Archæan.	*Palæozoic.*	*Mesozoic.*	*Tertiary.*
Maximum ...	77·6	16·8	2·27	0·384
Median	6·98	1·47	0·157	0·0758

The results show that large helium content is limited to specimens of great geological age, and is never found in the younger specimens. It is concluded that the helium has accumulated in beryl during geological time and that it was not present initially nor was it produced during the first few millennia by the decay of any short-lived radioactive constituent. A. H.

5244. Acceleration of Decomposition of Solids by the Emission from Radium. W. E. Garner and C. H. Moon. *Chem. Soc., J.* *pp.* 1398–1400, *Oct.*, 1933.—The thermal decomposition of crystals of barium azide is accelerated by the emission from radium. It is concluded that the effect is due to an acceleration of the growth of the nuclei and not to an increase in their number. The thermal decomposition of mercury fulminate is unaffected by the presence of radium. AUTHORS.

5245. Reflection of α-Particles by Heavy Nuclei. Ilse Merhaut and H. Wallner. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 7. *pp*. 297–306, 1933.—The reflection of RaC α-particles of different remaining ranges at surfaces of Ag, Cd, In, Sn, Sb and Te is investigated by the scintillation method for mean angles of scattering of 128°, 142° and 158°. The yield-range curve shows departures for certain ranges from that to be expected on the inverse square law and the type of anomalous behaviour exhibited depends upon whether the element is of even or odd atomic number. F. C. C.

5246. Long-Range α-Rays Emitted by the Active Deposit of Actinium. (Mme.) P. Curie and (Miss) W. A. Lub. *J. de Physique et le Radium*, 4. *pp*. 513–516, *Sept*., 1933.—A description is given of experiments carried out with preparations of the active deposit of actinium, the initial activity of which corresponded to that of 5 to 8 millicuries of RaC^1. The α-rays emitted were counted by the scintillation method. Precautions were taken to reduce the effect of parasitic radiation. Evidence of the emission of α-rays of range between 9 and 10 cm. was obtained, the ratio of the number of such long range α-rays to the number of α-rays emitted by AcC being about 3×10^{-7}. Brief reference is made to results obtained by an ionisation method confirming the above observations. W. E. P.

5247. Application of Probabilities to the Counting of α-Particles. N. I. Adams, Jr. *Phys. Rev.* 44. *pp*. 651–653, *Oct*. 15, 1933.—The Poisson law of probability is directly applicable to radioactive emissions only in certain simple case. In general, when a radioactive series such as the thorium series is present the probability function is complex. It can be found readily, however, if the interval of time for which probabilities are calculated is chosen so as to be either very short or very long compared with the mean life of each radioactive substance involved. The probability function for α-particles from the thorium series is determined on the basis of an interval of five minutes and is illustrated graphically in a special case. AUTHOR.

5248. Theory of the β-Disintegration. G. Beck and K. Sitte. *Zeits. f. Physik*, 86. 1–2. *pp*. 105–119, *Oct*. 17, 1933.—A treatment of the radioactive β-disintegration is given which takes into account that in this process the validity of the principles of conservation of energy and of spin impulse is no longer perceived. The disintegration formula obtained is applied to the form of the continuous β-spectrum and to the dependence of the β-emission on the disintegration energy and on the condition of excitation of the nucleus, and leads to a more accurate characterisation of the charges existing in the nucleus. A clear interpretation of the process considered can be furnished by the conception that in the β-disintegration a pair of electrons of dissimilar sign arises, of which the positive electron is simultaneously absorbed by the nucleus whilst the negative proceeds to emission. J. J. S.

5249. Penetrating γ-Rays from Actinium. (Mme.) P. Curie and P. Savel. *J. de Physique et le Radium*, 4. *pp*. 457–458, *Aug*., 1933.—The authors have measured the absorption in lead of the penetrating

γ-rays from actinium and its decay products, using a Hoffmann electrometer and a high pressure argon-filled chamber. A preliminary filter of 4 cms. of lead was used, the rays were canalised and the absorbing lead, of thickness up to 6 cm., was placed between the source and the canaliser. The mean value of $(\mu/\rho)_{Pb}$ is 0·076, corresponding to a mean wave-length of 13 X. U. No indication of a more penetrating radiation was found. For RaC γ-rays $(\mu/\rho)_{Pb}$ is 0·047 under the same conditions.
W. E. P.

5250. Interaction between γ-Rays and Atomic Nuclei. E. Stahel and H. Ketelaar. *J. de Physique et le Radium*, 4. *pp.* 460–485, *Aug.*, 1933.—The paper describes the investigation by absorption methods of the γ-radiation scattered by Pb, Fe, Sn, Al and U_3O_8. The source consisted of 1·6 mg. Ra. El, a geometric arrangement similar to that of Meitner and Hupfeld [see Abstract 1305 (1931)] and a high pressure chamber similar to that of Gray and Tarrant [see Abstract 4385 (1932)] being used. The radiation scattered by Pb contains two components attributed to nuclear scattering. The radiation scattered by Fe, Sn and U_3O_8 also contains a component attributed to nuclear scattering, the hardness of this component increasing with the atomic weight of the scatterer. The wave-lengths of the nuclear scattered radiation are derived from the absorption measurements and the results are compared with those of the workers referred to above. The Klein-Nishina formula is found to be compatible with the results for Al. W. E. P.

5251. Possibility of Emission of Positive Electrons from the Nucleus by γ-Rays. A. Bramley. *Frank. Inst., J.*, 216. *pp.* 427–428, *Oct.*, 1933.—It is deduced that if positive electrons exist in the nucleus, as experiments by Curie and Joliot on boron seem to show, then their photoelectric emission under the action of γ-rays from radioactive sources should be possible. The emission of protons, on the contrary, would be negligible. D. H. F.

5252. Physical Properties of the Positron. J. Thibaud. *Comptes Rendus*, 197. *pp.* 915–917, *Oct.* 23, 1933.—It is shown by the method previously described [see Abstract 4449 (1933)] that the specific charge of the positron is $\not<$ 1/2 and $\not>$ double that of the electron. Positrons are possibly emitted as a spectrum by radon and radiothorium, resulting from internal conversion of γ-radiation. Positrons are also produced by the action of γ-rays on Al, Cu, Ag, Pt, Pb, Bi, and U, the more readily the higher the atomic number of the element acted upon [see Abstract 2919 (1933)]. The coefficient of absorption of positrons is of the same order as that of electrons of the same average energy. The charge of the positron is considered positive, thus avoiding the necessity of Dirac's electron of negative energy. [See Abstract 2416 (1930).] C. A. S.

5253. Electrons Produced by Artificial Disintegration. Irène Curie and F. Joliot. *J. de Physique et le Radium*, 4. *pp.* 494–500, *Aug.*, 1933.—It is shown that the penetrating radiation emitted by Be when bombarded with α-particles is able to cause the emission of positive electrons when passing through various elements. The effect is shown to be due to the γ-rays contained in the radiation. A similar effect is produced by the γ-radiation from ThC″. It is suggested, in explanation of these phenomena, that the γ-radiation, by impact upon an atomic nucleus, is transformed into a positive and a negative electron—an effect which is termed "materialisation." An energy absorption of $1{\cdot}02 \times 10^6$ eV results from this process and this is therefore only produced by γ-radiation having an energy greater than this. An explanation of the known anomalous γ-ray absorption is offered on this basis. Positive electrons may also be produced together with the protons produced by α-particle bombardment of some elements and it is suggested that in this case a disintegration proton may occasionally be replaced by a neutron + a positive electron. J. E. R. C.

5254. Disintegration by High Velocity Protons. J. D. Cockcroft. *J. de Physique et le Radium*, 4. *pp.* 421–426, *Aug.*, 1933.—A survey of work done upon artificial disintegration produced by high velocity protons is made with particular reference to the author's own work. It is shown that the bombardment of lithium with protons results in the transformation: $Li^7 + p = He^4 + He^4$. Observations of the range/velocity distribution of the emitted particles reveals two groups, a fact which accounts for the simultaneous emission of γ-radiation. The yield of α-particles seems to be about one per 10^7 protons of 500 kV energy. The disintegration of boron appears to be $B^{11} + p = He^4 + He^4 + He^4$, the yield being about one α-particle per $2 \cdot 5 \times 10^6$ protons of 500 kV energy. The variation of yield with voltage for the above two elements is in good agreement with Gamow's calculations. The disintegration of several other elements is touched upon and the possible effect of this type of disintegration upon stellar processes is also discussed. J. E. R. C.

5255. Excitation of Neutrons on Beryllium. G. Bernardini. *Zeits. f. Physik*, 85. 9–10. *pp.* 555–558, *Sept.* 30, 1933.—Using a high pressure methane-filled ionisation chamber, the author has studied the dependence of the neutron emission from Be on the energy of the exciting Po α-particles. The Be was in the form of a thin hemispherical sheet of thickness less than 3 mm. air equivalent. The curve showing the ionisation as a function of the α-particle range has a maximum at 19 mm. air and a minimum at 26 mm. For greater ranges, no certain indication of further maxima and minima is obtained. The results are compared briefly with those of other workers. W. E. P.

5256. Velocity of Neutrons from Beryllium. G. Kirsch and Hertha Wambacher. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 5–6. *pp.* 241–249, 1933.—In the investigation of the neutrons from beryllium by the photographic method registration of the tertiary protons set in motion as point series indicates that this radiation is formed from a greater number of groups of homogeneous velocity, so that of one energy of excitation several various neutron velocities would be to be set in order. The order of magnitude of the relative intensity might be about the same for all the groups up till now established. The approximately 15 neutron velocities observed by this method distribute themselves almost uniformly in the interval from about 1 to 5×10^9 cm. sec.$^{-1}$. J. J. S.

5257. Production of Neutrons by High Speed Deutons. H. R. Crane, C. C. Lauritsen and A. Soltan. *Phys. Rev.* 44. *pp.* 692–693, *Oct.* 15, 1933. *Comptes Rendus*, 197. *pp.* 913–915, *Oct.* 23, 1933.—Using the apparatus previously described [see Abstract 4860 (1933)] LiCl and Be have been bombarded with deutons of energies up to 9×10^5 eV., giving several hundred times (the number is reduced by more than half if the paraffin coating of the inside of the electroscope is omitted) as many

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neutrons as previously obtained by bombarding Be with helium ions, while with 9×10^5 volts and the maximum deuton current about 100 times as many neutrons are obtained as with the strongest polonium source now in use. Bombardment with protons under similar conditions was without effect in the case of Be and very slight in that of LiCl [see Abstract 4040 (1933)]. Neutrons/voltage curves are given. Assuming the disintegrations to be $Be^9 + H^2 \rightarrow B^{10} + n^1$ and $Li^7 + H^2 \rightarrow 2He^4 + n^1$, and the mass of the neutron to be 1·0065, the kinetic energies of a neutron from Be, and of the two α-particles and neutron from Li are respectively 9 and 16×10^6 eV. C. A. S.

5258. Collisions of Neutrons with Light Nuclei. Part II. N. Feather. *Roy. Soc., Proc.* 142. *pp.* 689–709, *Nov.* 1, 1933.—A previous paper [see Abstract 4374 (1933)] gave an account of cloud track photography of the collisions of neutrons with nitrogen nuclei. The same method has now been applied to neutron-oxygen nucleus encounters and further series of photographs have likewise been obtained of the tracks produced in oxygen-hydrogen and acetylene-helium gas mixtures, respectively. Range distribution curves are given for the single recoil tracks resulting from elastic collisions and an attempt is made to analyse the curves referring to the mixtures of gases. Evidence is adduced for the presence of recoil protons due to neutrons produced in the resonance disintegration of beryllium and also for carbon recoil atoms due to neutrons of high energy. A criterion based upon the distribution of photographic density in the track image is suggested for the purpose of identifying recoil tracks produced by different atoms. Disintegration collisions in oxygen have been observed, but it appears that carbon nuclei are not readily disintegrated by the neutrons from polonium-beryllium. Only one such disintegration was found in more than 2000 photographs. Finally it is insisted that present knowledge of range-velocity relations for recoil atoms is quite inadequate for a full numerical investigation of the energy changes in the disintegrations observed. Further data are urgently needed. AUTHOR.

5259. Constitution of Atomic Nuclei. S. Shimasaki. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 384–399, *Oct.*, 1933. *In English.*—On the hypothesis that atomic nuclei would be composed of α-particles, $\left(\frac{\alpha}{2} + 1 \text{ neutron}\right)$-particles and neutrons, the constitution of nuclei of all the elements has been built, and a certain systematic relation between the nuclear constitution and the outer electronic configuration has been pointed out. As to the abundance of elements, the mass defect and the nuclear angular momentum explanations have been found in some cases. AUTHOR.

5260. Large Plate Condenser Method of Measuring Radioactive Substances. (Mme.) P. Curie. *J. de Physique et le Radium*, 4. *p.* 459, *Aug.*, 1933.—The paper points out that an ionisation chamber described by Piccard and Meylan [see Abstract 2339 (1933)] is of the same type as that which has been employed for a long time in radium measurements at l'Institute du Radium, and described in a number of publications. A comparison of the dimensions and sensitivity of the two chambers is made. W. E. P.

See also Abstracts 5220, 5261.

RADIATION.

ABSORPTION AND TRANSMISSION.

5261. Recrystallisation and Coloration. Part IV. K. Przibram. *Akad. Wiss. Wien. Ber.* 142. 2*a*. 5–6. *pp.* 251–257, 1933.—By micrometric measurements of the grain growth with pressed KBr crystals it is shown that the retardation of the recrystallisation by radium irradiation [see Abstract 420 (1931)] relates only to nucleus-formation and not to grain growth. The recrystallisation diagram of rock-salt has been extended to higher pressures, the diminution of the temperature coefficients of the velocity of recrystallisation as the deformation increases being confirmed. With KCl and KBr melt crystals, recrystallisation after pressing effects diminution of the lattice disturbances compared with that of the unpressed crystals. [For Part III see Abstract 2343 (1933).] T. H. P.

5262. Transmission of Infra-Red Radiation by a Thin Layer of Horn. H. J. Taylor. *Roy. Soc., Proc.* 142. *pp.* 598–605, *Nov.* 1, 1933.—A method is described for measuring the transmission in the infra-red region of the spectrum of a thin layer of horn, 0·022 mm. thick. Marked absorption was found in the region of 3·4μ, and also in the region beyond 6μ. AUTHOR.

5263. Intensity Filter for Hg Line 253·7 *mμ*. H. W. Melville and H. J. Walls. *Faraday Soc., Trans.* 29. *pp.* 1255–1259, *Nov.*, 1933.—A liquid filter is described for altering the intensity of the 253·7 *mμ* line from a mercury arc lamp. The absorbing liquid is sulphur free carbon tetrachloride which is mixed with *n*-hexane or cyclohexane. The extinction coefficients of a number of solutions were determined and found to obey Beer's law. The applicability of the filter is shown by experiments on the photochemical chain reaction between hydrogen and nitrous oxide at high and at low pressures where the rate is respectively proportional to the square root and to the first power of the intensity. AUTHORS.

See also Abstract 5131.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

5264. Electro-Optical Kerr Effect in Gases. C. W. Bruce. *Phys. Rev.* 44. *pp.* 682–686, *Oct.* 15, 1933.—The Kerr constant B of CO_2 has been measured as a function of density from 0·06 to 0·32 gm./cm³. and as a function of temperature from 7·2 to 34·6° C. The results are in agreement with the Langevin-Born theory. The absolute value of B for CO_2 has been measured and is $0\cdot34 \times 10^{-10}$ per atmosphere for wave-length 4550 Å and temperature 34·6° C. This is also the theoretical value of B for CO_2. The probable error of the measured value is 2 %. The absolute value of B for N_2 measured by comparison with CO_2 is $0\cdot057 \times 10^{-10}$ for the above wave-length and temperature, with a probable error of 3 %. The corresponding theoretical value for N_2 is $0\cdot050 \times 10^{-10}$. The Kerr constant of H_2 is shown to be less than $0\cdot01 \times 10^{-10}$, which is not in disagreement with the theoretical value of $0\cdot005 \times 10^{-10}$. AUTHOR.

5265. Kerr Effect in Gases and Vapours at Higher Temperatures. H. A. Stuart and H. Volkmann. *Ann. d. Physik,* 18. 2. *pp.* 121–149, *Sept.,* 1933.—An experimental arrangement is described which makes it possible to obtain absolute measurements of the Kerr constants of vapours at higher temperatures as far as 230° C. Possible errors and the order of accuracy obtained are discussed in detail. The way in which the Kerr constant of the dipole gas ethyl chloride varies with the temperature is measured between ordinary temperatures and 177° C. The observations confirm still further the Langevin-Born theory concerning the orientation of the Kerr effect. The Kerr constants are given for the first time for a number of organic vapours. The polarisation ellipsoids are calculated for ethyl nitrate and some of the ketones. Silberstein's theory which demands that in di-iso-propyl ketone the Kerr constant should be negative in contrast to the lower ketones is confirmed. A table is given of the Kerr constants of all the substances so far investigated by the authors, and also the polarisation ellipsoids and structural data calculated from them. H. L. B.

5266. Cotton-Mouton Constant of Nitrobenzene at the Transition Point. H. König. *Phys. Zeits.* 34. *pp.* 731–734, *Oct.* 1, 1933.—The temperature–Cotton-Mouton constant curve of nitrobenzene is continuous throughout the interval 5·7–20° C., *i.e.,* there is no discontinuity at the transition temperature reported by Wolfke and Mazur. At 20° C. and 5460 Å the value of the constant is $25 \cdot 7 \times 10^{-13}$. H. F. G.

5267. Magnetic Rotation Spectrum of the Red Bands of Sodium. W. R. Fredrickson and C. R. Stannard. *Phys. Rev.* 44. *pp.* 632–637, *Oct.* 15, 1933.—The magnetic rotation spectrum of the red bands of sodium shows a large number of doublets. A doublet is interpreted as made up of an R-branch and a P-branch line having a common upper K′ rotational level. The K′ values for the doublets are calculated and it is found that the rotational levels in the various initial vibrational states from 0–12 which give rise to magnetic rotation doublets are 53, 45, 33, 14, 60, 52, 43, 31, 16, 58, 51, 40, 28 respectively. That just these levels give rise to magnetic rotation lines suggests that these levels are perturbed. Since a $^3\Pi$ state is predicted to lie below the upper $^1\Sigma$ state we have perhaps here evidence of a perturbation between a $^1\Sigma$ and a $^3\Pi$ state. To account for the magnetic rotation doublets it has been necessary to revise the vibrational numbering, increasing the initial state numbering by three. AUTHORS.

5268. Paramagnetic Faraday Effect in Alums. H. Kaufmann. *Ann. d. Physik,* 18. 3. *pp.* 251–264, *Oct.,* 1933.—The Faraday effect was experimentally investigated in regular chrome and iron alums. By comparison with the isomorphic Al alums, the paramagnetic and diamagnetic effects could be separated. By comparing the results with theory it is found that the Fe^{+++} ion which is in a 6S state ought to have no paramagnetic part, but experiment shows that this part is large. Further, according to Bethe's theory, S and P states are not affected by the cubic field, but this is very probably the case for the D, F and G states. G. E. A.

See also Abstract 5461.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

5269. Resonance Function in Collisions of the Second Kind. W. Hanle and K. Larché. *Zeits. f. Physik*, 85. 9–10. *pp.* 548–554, *Sept.* 30, 1933.—The effective cross-section, energy transfer, and yield in collisions of the second kind are calculated from polarisation measurements on the resonance fluorescence of sodium vapour in a magnetic field. The results are compared with the calculations of Kallmann and London.
W. R. A.

5270. Fluorescence of Diatomic Molecules of Arsenic. P. Swings and M. Migeotte. *Comptes Rendus*, 197. *pp.* 836–838, *Oct.* 16, 1933.—Four resonance series have been obtained from the vapour of arsenic excited by the mercury lines at 2536(2), 2483(3), 2654(3), and 2805(4) respectively, the terms of the first three series consisting of doublets or triplets corresponding to the complexity of the exciting lines. The first series is most intense, but the last is too weak for measurement. The fundamental frequency of As_2 is found to be about 410 cm^{-1}. The value of the interatomic distance calculated from the Morse formula is $1 \cdot 94$ Å as compared with the minimum distance $2 \cdot 51$ Å in the crystals, and the moment of inertia is 234×10^{-40} $gm.cm^2$. All the terms observed appear to be simple, indicating the existence of a Q-branch only. If P − R doublets do occur, their calculated separation is $1 \cdot 8$ Å, which would be observable with the dispersion employed. C. B. A.

5271. Fluorescence of Aetoporphyrin. Constitution and Spectrum of Porphyrin. H. Hellström. *Arkiv f. Kem. Min. och Geologi*, 11.*B*. 11. [5 *pp.*], 1933. *In German.*—The fluorescence excited by various wave-lengths of light from a monochromator served by an arc has been examined. Excitation of aetoporphyrin with light of the same wave-length as the absorption bands causes variations in the intensities of those fluorescence bands not coinciding with the excitation band. This only occurs for solutions in C_5H_5N, not in ether. This is due to the production of photoporphyrin probably formed by the dehydrogenation of aetoporphyrin. J. E.

5272. Quenching of Iodine Fluorescence by Iodine and Argon. J. F. Koehler. *Phys. Rev.* 44. *pp.* 761–768, *Nov.* 1, 1933.—In iodine below pressures of $0 \cdot 8$ mm. fluorescence was excited monochromatically by the mercury green and yellow lines and measured by photographic photometry with a spectrograph. Absorption measurements were made under similar conditions with two compensating photo-electric cells: Beer's law holds here; and argon does not alter the absorption of iodine. The ratio of probability of an excited molecule losing all energy in an iodine collision to probability of radiation is evaluated per unit time. The ratio exceeds unity for pressures above $0 \cdot 05$ mm. The yellow excited series is quenched more than the green by both iodine and argon. The complex nature of argon quenching is discussed. AUTHOR.

5273. Decay of Luminescence and Light Absorption in Phosphorescent Materials. D. H. Kabakjian. *Phys. Rev.* 44. *pp.* 618–624, *Oct.* 15, 1933.—With continuous irradiation with α, β and γ-rays the light absorption coefficient of certain phosphorescent materials reaches a characteristic saturation value which is a function of the intensity of the radiation and the temperature at which the irradiation takes place, but is independent of the variations in the light emission of the material and also of the total amount of energy absorbed by it. The experimental curves of the rise and decay of phosphorescence and of the changes in light absorption coefficient of these materials cannot be explained by the generally accepted theories of these phenomena. AUTHOR.

5274. Fluorescence of Fluorite. H. Haberlandt and K. Przibram. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 5–6. *pp*. 235–239, 1933.—The well-known blue fluorescence of fluorite may be, like the red radio-photo fluorescence, destroyed by heat and regenerated by exposure to radioactive rays. The red fluorescence has a lower temperature range, disappearing reversibly between 40 and 50° C. The fluorescing power can be weakened by too great an exposure to the rays, but can be fully restored by carefully controlled heating. Many natural fluorites appear to have suffered from over-exposure. In an additional note the authors state that the red fluorescence can be induced by treatment with Ca vapour in a vacuum. [See Abstract 4878 (1933).] J. E.

5275. Spectrum of the Afterglow of Carbon Dioxide. A. Fowler and A. G. Gaydon. *Roy. Soc., Proc.* 142. *pp*. 362–369, *Nov*. 1, 1933.—It is found that the spectrum of a CO flame burning in air is identical with the spectrum of the afterglow of CO_2. The spectrum of the exciting discharge indicates that the afterglow is generated by the interaction of excited neutral molecules of CO with neutral molecules of O_2. Under the conditions giving rise to the afterglow there is no evidence of dissociation of the CO_2 other than into neutral molecules of CO and O_2. The OH bands which occur in the spectrum of the afterglow probably originate in interactions between the excited CO or O_2 molecules and water vapour in quantities too small to reveal its presence in the exciting discharge. The observations favour the view that the bands of the CO_2 afterglow and of the CO flame are produced by the direct combination of CO and O_2 without dissociation into atoms of C and O or molecules of carbon. The great complexity of the bands also supports the idea that the afterglow bands are due to CO_2. A. H.

INTERFERENCE. DIFFRACTION AND SCATTERING.

5276. Interference of Light in Metallic Films. J. B. Nathanson. *J.O.S.A.* 23. *pp*. 388–393, *Nov.*, 1933.—A method is described for depositing a thin metallic film on a pyrex glass plate by sputtering in such a manner that, due to the relatively rapid change in thickness of the film across the plate, a series of interference fringes can be seen in reflected light. The possibilities of using this phenomenon to estimate the thickness of the film are investigated for Mn and Pt, by comparison with the mass of metal deposited as determined by accurate weighing. Good agreement is found for Mn, but a considerable discrepancy occurs in the case of Pt. Various reasons for the discrepancy are suggested. W. D. W.

5277. Scattering of Light by Excited Atoms. V. Weisskopf. *Zeits. f. Physik*, 85. 7–8. *pp*. 451–481, *Sept*. 23, 1933.—Certain modifications of the Kramers-Heisenberg formula are found necessary when account is taken of the finite life period of the atomic states concerned. In the case of scattering of monochromatic light by an excited atom these modifications indicate a finite width for the scattered lines and the appearance, in the scattered spectrum, of atomic frequencies not predicted by the usual formula. A general scattering formula is deduced for scattering processes of higher order, *i.e.*, processes involving more than two quanta. L. A. W.

5278. Experimental Evidence for the Absence of Scattering of Light by Light. F. L. Mohler. *J.O.S.A.* 23. *pp.* 386–387, *Nov.*, 1933.—A possible interpretation of certain theoretical relations is that photons will repel and scatter each other at a distance comparable with the wave-length of the radiation. To test this possibility, light from two projection lamps was brought to a common focus by two large aperture mirrors. The focal point at the centre of an evacuated bulb was viewed at right angles to the beams of light by means of a viewing tube sighting into a black enclosure. There was no perceptible scattering of the light. The least perceptible light was measured and found to be about 5×10^{-9} of the brightness of the focal spot on a white surface. The radiation density at the focus was comparable to that in an enclosure at 2000° K through a volume of c.c. From this it is estimated that if there is any interaction the scattering radius for photons of visible light is less than 5×10^{-9} cm. or 10^{-4} of a wave-length. AUTHOR.

5279. Theory and Use of Interference Refractometer. H. Schardin. *Zeits. f. Instrumentenk.* 53. *pp.* 396–403, *Sept., and pp.* 424–436, *Oct.*, 1933.—Describes the construction and principle of the Mach-Zehnder interference refractometer which is similar in many respects to the Jamin refractometer. The use of the instrument for studying the form of the isotherms in the air surrounding a heated object is described and the theory necessary for obtaining the isotherms from the interference diagram is given in the second part of the paper (theoretical). The application to the study of the waves surrounding an object in rapid flight is also described and examples are given. The instrument may be used, like other interferometers, for examining transparent materials for strain and for lack of homogeneity. The theory of the instrument is very completely worked out in the second half of the paper. J. W. T. W.

5280. Polarisation Interferometer. A. Dufour. *Comptes Rendus*, 197. *pp.* 831–833, *Oct.* 16, 1933.—An interferometer is described in which the interfering beams are plane polarised. It is so arranged that the path difference to be measured produces a small ellipticity in one of them, and linear polarisation is restored by means of a compensator, such as a Kerr cell or a glass block under pressure. The accuracy so far obtained is only 1/40 of a fringe, but this could be improved by retouching the optical surfaces. C. B. A.

See also Abstracts 5130, 5290.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

5281. Photochemistry of the AgCl-Crystal. F. Löhle. *Göttingen Nachrichten, Math.-Phys. Klasse. No.* 3. *pp.* 271–277, 1933.—The photochemical reaction products in silver chloride crystals give absorption bands at very small concentrations (maximum absorption constants below 0·01 mm^{-1}), which must be ascribed to colloidal flocks of particles. The production of discoloration at −186° and the execution of absorption measurements within 1½ mins. after the end of the colour change leads to the same result. H. H. Ho.

5282. Quantum Yields of the Photochemical Reactions of Phosgene. C. W. Montgomery and G. K. Rollefson. *Am. Chem. Soc., J.* 55. *pp.* 4025–4035, *Oct.*, 1933.—The quantum yields have been measured for the photochemical oxidation of phosgene, the phosgene-sensitised oxidation of carbon monoxide, and the photochemical reaction of phosgene with hydrogen, the results confirming the rate mechanisms which are proposed for the three reactions. The rate of the photochemical reaction between phosgene and hydrogen has been investigated and a mechanism is suggested from which the theoretical law $\frac{d\,(\mathrm{CO})}{dt}=k\,\mathrm{I}_0\,(\mathrm{COCl_2})\left[1+\frac{k_2\,(\mathrm{H_2})}{(\mathrm{CO})\,(\mathrm{M})}\right]$ is derived. This expression is in substantial accord with the experimental facts. The reaction rate is discussed from the standpoint of this rate law, and it is pointed out that the absence of formaldehyde formation is probably due to the non-reactivity of COCl towards H_2. This non-reactivity in turn is believed to cause an increase in the concentration of COCl, so that $2\,\mathrm{COCl}\rightarrow\mathrm{COCl_2}+\mathrm{CO}$ becomes the chain-terminating process. [See Abstracts 1448 and 1449 (1933).] T. H. P.

5283. D.I.N. System of Grading Photographic Plates. M. Biltz. *Naturwiss.* 21. *pp.* 734–736, *Oct.* 13, 1933.—Surveys recent methods of determining the sensitivity of photographic plates and films, with a detailed description of the D.I.N. grading which is based on work carried out at various laboratories and described by Luther at the 8th International Congress for Scientific and Applied Photography held at Dresden in 1931. J. H. A.

5284. Characteristic Curves of Photographic Plates in the Ultra-Violet. B. K. Johnson and M. Hancock. *Journ. Sci. Instruments,* 10. *pp.* 339–344, *Nov.,* 1933.—The paper describes investigations into the behaviour of certain photographic plates in the ultra-violet region of the spectrum, which were made with a view to obtaining the most suitable type for ultra-violet microscopy. Characteristic curves of these ultra-violet plates have been determined; their relative speeds, contrast factors, and suitability for particular wave-lengths are also discussed. AUTHORS.

5285. Sensitisers for Red and Infra-Red Regions. W. Dieterle, H. Dürr and W. Zeh. *Zeits. f. wiss. Phot.* 32. *pp.* 145–156, *Oct.,* 1933.—After a brief general survey of the development of infra-red sensitisers, in which it is mentioned that Scheibe first made a suitable material which was eventually obtained pure by American and British research workers, and put on the market as kryptocyanin and rubrocyanin, two particular materials are dealt with. They are penta-carbocyanin and hepta-carbocyanin, the considerations being wholly concerned with developments which have taken place in Germany since 1918. Finally, the sensitising regions are given for various forms of these two compounds. R. C. F.

5286. Highly-Dispersed Emulsions. Part II. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 32. *pp.* 182–184, *Oct.,* 1933.—Further considers the causes of the higher sensitivity of silver chloride compared with silver bromide, and shows that it cannot be attributed to the greater light absorption due to the opacity of the highly-dispersed silver chloride. A similar retardation of the grain growth to that already shown to exist with silver chloride is illustrated by numerous dyes with silver bromide. This retardation is not completely compensated by ripening after dye treatment, but ripening before dye treatment produces a much higher colour sensitivity than is shown by after ripening. [See also Abstract 828 (1932).] R. C. F.

5287. Action of Silver Iodide on Silver Bromide. Lüppo-Cramer. *Phot. Indust.* 31. *p.* 972, *Oct.* 18, 1933.—Discusses, in the light of published results, the differences in photographic action obtained using a AgBr emulsion containing AgI, when compared with a pure AgBr emulsion. The retardation of grain growth, solarisation, and influence of the gelatin are briefly considered. R. C. F.

5288. Latent Image. C. Winther. *Zeits. f. wiss. Phot.* 32. *pp.* 157–181, *Oct.*, 1933.—The results obtained by repeating Kof and Haehn's experiments showed that the observations—that the reactive mixture of $HgCl_2$ and $SnCl_2$ acts on $HgCl_2$ solution, and Eder's solution, due to the emission of mercury vapour—were correct. The same mixture also acts on a photographic plate through the emission of Hg vapour and HCl, which in the presence of oxygen produce $HgCl_2$. The reduction of mercuric chloride to mercurous chloride by means of mercury in the plate causes the formation of a latent image. A simple expression is developed which is shown to be satisfactorily represented by the blackening curve of the plate, and which proves that there is a definite number of latent nuclei and fog nuclei in the photographic plate, both of which can be activated by radiation. Plates of small sensitivity contain a larger number of latent nuclei, which are joined together by ripening and at the same time assume a stronger catalytic action with development, the number of these nuclei being increased by peptising with water vapour, although their catalytic action is reduced. The fog nuclei, although they have a strong catalytic action with development, are considerably reduced by KBr, but are unaffected by $HgCl_2$. Light-activated latent nuclei possess a much smaller catalytic action with development, but the light-activation is increased by $HgCl_2$ and by KCl, these compounds only slightly reducing the number of latent nuclei. Treatment of the fog nuclei with $HgCl_2$, after they have been covered by radiation with energy quanta, causes them to return to their original state. The results show that the latent nuclei consist of a single molecule of silver sulphide for low sensitivity plates or two molecules if the plates have a high sensitivity, whilst fog nuclei are composed of three molecules of silver sulphide. Finally, it is shown that the development constant varies linearly with the intensity but is unconnected with the time of illumination. R. C. F.

See also Abstracts 5263, 5302.

PHOTOMETRY.

5289. Determination of Mean Effective Wave-Lengths and Their Application in Heterochromatic Photometry. H. Buckley. *Journ. Sci. Instruments*, 10. *pp.* 351–357, *Nov.*, 1933.—The paper describes how the spectrophotometer described by Buckley and Brookes [see Abstract 820 (1931)] can be used for the experimental determination of mean effective wave-lengths of colour filters. The method is used for the determination of the mean effective wave-lengths of 3 glasses for the temperature interval 2000–2800° C., and the results compared with those obtained by calculation using the internationally agreed visibility data. The possibility of the use of mean effective wave-lengths in heterochromatic photometry by visual, photoelectric and thermoelectric methods, is pointed out.

Author.

See also Abstracts 5303, 5348.

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POLARISATION.

5290. Precise Measurement of Optical Path-Difference, Especially in Stressed Glass. R. W. Goranson and L. H. Adams. *Frank. Inst., J.* 216. *pp.* 475–504, *Oct.*, 1933.—The various methods available for measuring optical path difference are discussed and in particular the properties possessed by a fixed combination of (1) a polariser, (2) the birefracting material, and (3) a quarter-wave plate, each placed in a definite orientation to the others, are investigated. When plane parallel monochromatic light passes through the elements of this combination in the order shown, the emergent light is plane polarised and the azimuth is related in a simple manner to the path-difference of the specimen. Apparatus is described with which this azimuth can be measured with high precision and a sensitivity about one hundred times greater than that of devices in common use is claimed. A résumé of the general relations for elliptically polarised light as applied to the present method is given, and the magnitude of the errors that may arise is discussed in detail. W. D. W.

See also Abstract 5269.

RADIATION, EMISSION.

5291. Emission Constants of Metals in the Near Infra-Red. C. Hurst. *Roy. Soc., Proc.* 142. *pp.* 466–490, *Nov.* 1, 1933.—The emissivity of copper has been determined over a wave-length range extending from 1·5μ to 5μ at the two temperatures, 700° C. and 850° C.; and the emissivity of nickel over the range 1·25μ to 6·5μ at 850° C. and the range 1μ to 6·5μ at 1000° C. The emissivity for a given wave-length was measured directly as the ratio between the energy received from a given area of the radiating metal and the energy received from an equal area of a black-body slot cut in the metal and radiating, therefore, at the same temperature as the metal. The method possesses the following advantages: (1) The emissivities can be measured with a far greater accuracy than is possible by employing a reflection method. (2) The comparison black-body emission is measured, and not calculated from the laws of full radiation. (3) Since the metallic radiation and the black-body radiation are of the same temperature, it is not necessary to measure the temperature of the radiator with a high degree of precision; in fact, it was measured only because it was desired to investigate how the reflection coefficients varied with the temperature. The results have been compared with the values predicted by the classical theory of Drude and by the quantum-mechanical theory of Krönig; the latter theory is shown to fit the facts less well than the former. An argument based on general grounds has been advanced in support of this conclusion. AUTHOR.

5292. Radiation of Metal Surfaces Bombarded by Positive Alkali Ions. H. Mayer. *Phil. Mag.* 16. *pp.* 594–606, *Sept.*, 1933.—Alkali ions which impinge on surfaces of platinum, copper and aluminium are caused to emit a characteristic radiation consisting of the line spectrum of the alkali atom. The surface of the metal is covered by a thin luminous layer. The author studies the influence of the surface conditions of the bombarded metal upon the intensity of the current and of the velocity of the positive ions upon this radiation. An explanation of the origin of the radiation is proposed and discussed. H. L. B.

5293. Penetrating Radiation. Irène Curie and F. Joliot. *J. de Physique et le Radium,* 4. *pp.* 492–493, *Aug.,* 1933.—Experiments are described which were designed to discover a projection of atomic nuclei due to the impact of cosmic radiation. No such effect was detected and it is concluded that, at the most, only a small part of cosmic radiation can consist of neutrons. J. E. R. C.

5294. Solar Activity and Cosmic Rays. V. F. Hess and R. Steinmaurer. *Nature,* 132. *p.* 601, *Oct.* 14, 1933.—The intensity of the cosmic radiation on the summit of the Hafelekar has been recorded almost continuously [see following Abstract] for two years. The room-temperature in the observatory was kept constant within ± 0·1° at 15° C. during the whole of the period by an automatic regulator. All ionisation values were reduced to the same barometric pressure and outdoor temperature. A small diurnal variation according to local time was demonstrated, the maximum intensity occurring at 2 p.m., indicating some indirect action of the sun. No certain correlation between intensity and the occurrence of sunspots was recorded; a slight decrease was indicated after the commencement of magnetic storms. As a whole the results are considered to support the corpuscular theory of cosmic radiation. F. C. C.

5295. Registration of Cosmic Radiation on the Hafelekar (2300 m.) at Innsbruck. Part I. V. F. Hess and R. Steinmaurer. *Preuss. Akad. Wiss. Berlin, Ber.* 15. *pp.* 521–542, 1933.—Taking a very great number of precautions and making due allowance for temperature and pressure, the changes in the intensity of cosmic radiation have been measured with a Steinke standard high-pressure ionisation chamber (22l, CO_2 at 9 atm.) at a height of 2300 m. for over a year. With full-screening (10 cms. of Pb) and half-screening the mean ionisations for the year were 2·759 J and 4·56 J respectively where J = 1 ion-pair/cc./sec. No appreciable variation occurs over the entire year, but the seasonal departures from the mean are about 1 %. Comparison of the intensities by day and night show an increase during the former of about 2 %. Variations also occur over sidereal time but the fluctuations are only about 0·1 %. The existence of aperiodic fluctuations (fluctuations of the second kind) is established. [See following Abstract.] F. C. C.

5296. Registration of Cosmic Radiation on the Hafelekar (2300 m.) at Innsbruck. Part II. R. Steinmaurer and H. Graziadei. *Preuss. Akad. Wiss. Berlin, Ber.* 22. *pp.* 672–685, 1933.—The meteorological and secondary solar influences, for which correction had been made in the results quoted in Part I [see preceding Abstract], are here discussed in detail. The effects of humidity, cloud and open-air temperature are in agreement with expectation when the absorption and scattering due to water vapour are considered. Fully screened apparatus showed no variation in intensity of the radiation with an increase in the solar intensity as determined by a Fuess sunshine register, but there was a proportional increase with the half-screened apparatus. This particular solar effect is probably associated with the liberation of radioactive emanations from the Earth's crust as the temperature rises. Owing to the radioactive material carried down, an increased effect is observed after a snow-storm. Considering primary cosmic factors it is suggested that the aperiodic fluctuations are related to the appearance of sunspots, but the results are not sufficiently extensive for definite conclusions to be

drawn. A correlation is also established between magnetic storms and the cosmic ray intensity, but the precise connection is still obscure.
F. C. C.

5297. Cosmic Corpuscular Ultraradiation. Part V. Ionisation in the Stratosphere and in the Highest Layers. J. Clay. *K. Akad. Amsterdam, Proc.* 36. 1. *pp.* 62–70, 1933.—From the author's calculation, the conductivity of the atmosphere increases rapidly at a height somewhere between 80 and 90 km., and reaches, at 90 km., a value corresponding to the conductivity of humid earth. It is shown that the secondary radiation which comes from below is capable of producing high conductivity at very great altitudes. [See also Abstract 1870 (1933).]
G. E. A.

5298. Absorption of Cosmic Radiation. H. J. Bhabha. *Zeits. f. Physik,* 86. 1–2. *pp.* 120–130, *Oct.* 17, 1933.—Investigation is made of the rôle played by "showers" in the absorption of cosmic radiation. It is sought to formulate the simplest hypotheses which attain to agreement with the experimental findings on the absorption of this radiation. It is found that the hypothesis of complete absorption through the production of the showers suffices to explain the existing experimental facts. By comparison with experiment numerical results are calculated for the various processes concerned, as, *e.g.*, the effective cross-section for the production of showers at a lead nucleus. J. J. S.

5299. Energy Distribution in Cosmic Rays. W. G. Pollard. *Phys. Rev.* 44. *pp.* 703–706, *Nov.* 1, 1933.—The experimental evidence from the distribution of cosmic rays with magnetic latitude and from their absorption in the atmosphere demands that they have some sort of energy distribution. Examination shows that passage through interstellar space would not have appreciably distorted an energy band in cosmic-ray particles which have been travelling for 5×10^{12} years. Consequently, it seems probable that they have preserved the energy distribution with which they were originally emitted. A Maxwell distribution in energy corrected for relativity is applied to functions which approximate Lemaître's and Vallarta's curves for the latitude effect and fairly good agreement with Compton's observations is obtained when 16·7 % of the radiation has the Maxwell distribution, the remainder being composed of particles unaffected by the earth's magnetic field. These results are applied to Lemaître's theory of the radioactive origin of the radiation. The distribution found has many features which suggest such an origin although the recent findings of Johnson and those of Alvarez and Compton, indicating that there are more positive than negative electrons in the rays, seem to discredit such a theory. AUTHOR.

RADIATION, GENERAL THEORY.

See Abstracts 5278, 5291.

REFLECTION. REFRACTION AND DISPERSION.

5300. Nature of Polish Layers. J. A. Darbyshire and K. R. Dixit. *Phil. Mag.* 16. *pp.* 961–974, *Nov.*, 1933.—The polished surfaces of the elements Bi, Sb, Zn, Te, Cd, Au, Ag, Pb, Mo, Cu, Cr, Se, Si have been examined by means of electron diffraction. In all these cases the polish layer appears to be amorphous, resembling a supercooled liquid. This was suggested originally by Beilby, and later confirmed by French [see Abstract 3526 (1933)], who examined Au, Ag, Cr, Cu, using electron diffraction methods. From the positions of the diffraction rings the interatomic distances are deduced, and it is found that in many cases the atoms do not retain their normal size as on the atomic volume curve. In the case of the conductors, which include all but the last two, the atoms appear to be stripped and have atomic volumes corresponding in all cases more nearly to the minimum values of the normal atomic volume curve. In the case of the non-conductors Se and Si, however, the normal interatomic distance is preserved. Two semiconductors, PbS and FeS_2, were also examined, and here the rings are merely due to very small size of the crystal particles after polishing. There was no evidence in these cases of the amorphous rings observed for the elements. AUTHORS.

5301. Optical Theory of a Non-Homogeneous Medium. M. Herzberger. *Zeits. f. Instrumentenk.* 53. *pp.* 436–443, *Oct.*, 1933.—A mathematical treatment, by the method of vector analysis of the paths of the rays passing through a non-homogeneous but isotropic medium (n is a function of the position of a point but not of the direction of propagation of the light at that point). Image formation is dealt with in the second part of the paper which is too mathematical to be usefully abstracted. J. W. T. W.

5302. Deviations of an Inclined Beam of Finite Aperture in the Meridian Section of a Centred Lens System. A. W. Tronnier. *Phot. Indust.* 31. *pp.* 953–956, *Oct.* 11, 1933.—The state of meridional coma can be obtained by trigonometrical calculations by employing one of several easy methods of calculation. Difficulties arise, however, in that no criteria exist for coma, but only conditions under which expressions may be obtained to state the corrections for coma. The procedure is set out for determining the magnitude of the coma with a bundle of rays of finite diameter which occurs laterally along the axis for given points of the object in the case of a centred system with known refractive index and curvature. A second procedure is also used to obtain the distortion due to coma. The condition for no coma is also stated. R. S. R.

• **5303. Light Beam of Uniform Intensity of Cross Section. J. T. Lay and I. C. Cornog.** *Rev. Sci. Instruments*, 4. *pp.* 600–602, *Nov.*, 1933.—The article deals with a photoelectric method of measuring the intensity of a beam of light at any point of its cross-sectional area. The application of this method led to the production of a light beam the intensity of which over an area 30 cm. × 30 cm. varied by less than one-third percent. AUTHORS.

5304. Refractive Index of Quartz in Infra-Red. C. Müller and A. Wetthauer. *Zeits. f. Physik*, 85. 9–10. *pp.* 559–560, *Sept.* 30, 1933. *From the Reichsanstalt.*—Measurements made on the refractive index of a fused quartz prism are described and a table of values is given of the indices for wave-lengths over the range of $0\cdot5$—$2\cdot6\ \mu$. W. D. W.

5305. Theory of Forced Double Refraction. K. F. Herzfeld and R. H. Lee. *Phys. Rev.* 44. *pp.* 625–631, *Oct.* 15, 1933.—An attempt is made to understand the nature of the double refraction in crystals by calculating the forced double refraction induced in rock-salt and KCl crystals through elastic stress (photoelasticity). In a previous paper only the change in the Lorentz-Lorenz force had been taken into account. In this paper is also considered the " potential dip " which is due to the forced anisotropic arrangement of the ionic charges. The formulæ are developed according to classical theory and to wave mechanics but they contain too many unknown constants to be checked against experiment. AUTHORS.

See also Abstracts 5126, 5143, 5144, 5195, 5291, 5309, 5365, 5366, 5367.

SPECTROSCOPY.

5306. Spark Spectrum of Iron in Extreme Ultra-Violet. L. and E. Bloch. *Comptes Rendus,* 197. *pp.* 679–680, *Oct.* 2, 1933.—Measurements were made from 1350 Å to 300 Å using a grating at grazing incidence. Lines of carbon were used as standards for wavelength measurement and an accuracy of 0·02 Å is claimed in most cases. F. S.

5307. Elimination of Errors Due to Absorption in the Prism, and other Causes, in Infra-Red Absorption Measurements. D. G. Drummond. *Univ. Durham, Phil. Soc., Proc.* 9. *pp.* 55–60, *June,* 1933. —Consideration is given to error arising out of differential absorption of two beams in a prism and to the arrangements in the optical system external to the spectrometer by which this and other errors may be avoided. AUTHOR.

5308. Pressure Effects of Nitrogen on Potassium Absorption Lines. W. W. Watson and H. Margenau. *Phys. Rev.* 44. *pp.* 748–752, *Nov.* 1, 1933.—Pressure effects on the first three doublets of the principal series of the potassium absorption spectrum have been produced by nitrogen up to 30 atmospheres pressure. The 4045 Å and 3446 Å pairs show shifts of the absorption maxima to the red and half-widths more than twice as large as those for the resonance lines. In the range of nitrogen pressures above " relative density " 10 both the shifts and the half-widths increase more rapidly than linearly with density. The ${}^2P_{\frac{1}{2}}$ components exhibit this departure from the linear relation more markedly than the ${}^2P_{1\frac{1}{2}}$ components. Possible explanations of these variations are suggested. Quantitative results are summarised in the figures and tables. [See Abstract 4091 (1933).] AUTHORS.

5309. Resonance Lines of Silver. A. Filippov and I. Islamov. *Zeits. f. Physik,* 85. 5–6. *pp.* 409–410, *Sept.* 14, 1933.—The anomalous dispersion in the neighbourhood of the $5^2S_{\frac{1}{2}} - 5^2P_{\frac{1}{2}, \frac{1}{2}}$ doublet of silver has been investigated. The ratio of oscillator-strength of the doublet components is given as 2·03 ± 0·06. F. S.

5310. Arc Spectrum of Cerium. P. Karlson. *Zeits. f. Physik,* 85. 7–8. *pp.* 482–503, *Sept.* 23, 1933.—A number of new lines of the cerium arc spectrum are found experimentally. A beginning is made with the analysis of the CeI spectrum, 540 of the approximately 3000 recorded lines being classified as due to transitions between 105 energy levels. It is found possible to ascribe inner quantum numbers to the levels, and some progress is made with their grouping into terms. The ground term of the CeI spectrum is an a^3H^0 term of the configuration $4f5d6s^2$. From this and the assumed next higher series member extrapolation gives the value 6·54 volts for the ionisation potential (observed value 6·91). L. A. W.

5311. Regularities in the Spectrum of Doubly Ionised Cerium. P. N. Kalia. *Indian Journ. Phys.* 8. *pp.* 137–145, *Oct.* 7, 1933.—The paper gives a list of 111 lines between λ 3544 and 2203, of doubly ionised cerium which have been analysed. Almost all the strong lines are included in the analysis. The fundamental state corresponds to a ^{3}F term of $5d^2$ configuration. The other states which have been located originate from $5d^2$, $6s^2$, $5d6s$ and $4f6s$ configurations. Large number of other terms are also given whose nature could not be determined unambiguously. The strong similarity with the spectrum of La II is shown. AUTHOR.

5312. Spectra of Potassium in Successive Stages of Ionisation. M. Ram. *Indian Journ. Phys.* 8. *pp.* 151–161, *Oct.* 7, 1933.—The paper gives an analysis of K III, K IV, K V and K VI lines in the extreme Schumann region below λ 1100. Almost all the important lines of K III, K IV and K VI spectra in this region have been identified, and formed into completed multiplets which are given along with the terms. Of K V only the $3s^2\ 3p^3\ {}^4S - 3s\ 3p^4\ {}^4P$ multiplet could be located. AUTHOR.

5313. Spectra of Trebly and Quadruply Ionised Calcium. M. Ram. *Indian Journ. Phys.* 8. *pp.* 163–170, *Oct.* 7, 1933.—An analysis of the existing data for the spark lines of calcium has been made and practically all important combinations with the fundamental states of Ca IV and Ca V have been identified. 14 terms with 27 lines of Ca IV and 24 terms with 36 lines of Ca V are tabulated. AUTHOR.

5314. Arc Spectrum of Sulphur. K. W. Meissner, O. Bartelt and L. Eckstein. *Zeits. f. Physik*, 86. 1–2. *pp.* 54–76, *Oct.* 17, 1933.—The spectrum of a condensed discharge through sulphur vapour is photographed, using a plane grating with a mean dispersion of 18 Å per mm. and a concave grating giving 5·7 Å per mm. Wave-length determinations are given for 275 lines lying between 8700 and 3400 Å. Besides the spark lines of sulphur the arc lines occur strongly. It is found possible to complete the term system of SI and to classify numerous lines previously measured by Frerichs [see Abstract 1481 (1933) and following Abstract]. L. A. W.

5315. Spark Spectrum of Sulphur, S II. O. Bartelt and L. Eckstein. *Zeits. f. Physik*, 86. 1–2. *pp.* 77–81. *Oct.* 17, 1933.—Wave-length determinations are given for 45 new lines between 8523 and 3792 Å belonging to the spark spectrum of sulphur which appears along with the arc spectrum in a condensed discharge through sulphur vapour [see preceding Abstract]. The lines are classified as combinations between known terms, and in addition the new terms $3s^2\ 3p^2\ 3d\ {}^4P$ and $3s^2\ 3p^2\ 5p$ $^4S\ {}^4P\ {}^4D$ are determined. L. A. W.

5316. Arc Spectrum of Sulphur in the Ultra-Violet. J. E. Ruedy. *Phys. Rev.* 44. *pp.* 757–760, *Nov.* 1, 1933.—A Schüler tube with a water-cooled aluminium kathode, with He gas for maintaining the discharge, was attached to a vacuum spectrograph employing a 1·5 m. grating of 15,000 lines per in. The sulphur spectrum was excited by vaporising some sulphur in the tube while the discharge was in operation. The wave-length range photographed was from 0–2600 Å, and in the region 1050–2400 Å many new lines were observed and classified. It was thus possible to establish the low singlet terms of the arc spectrum and some

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of the higher terms built on the doublet P and D states of the ion as well as some higher members of series built on the quartet S state of the ion. AUTHOR.

5317. Intensity and Structure of Spectral Lines. V. F. I. Weisskopf. *Observatory,* 56. *pp.* 291–308, *Oct.,* 1933.—A quantum-mechanical and a brief classical investigation are given of the theoretical contours of the absorption and emission lines of atoms which absorb light from a continuous spectrum source. The investigation deals especially with the conditions prevailing in the interiors of stars. The influence of the Doppler effect on the contours of spectral lines is briefly discussed and it is concluded that its effect is negligible in most astrophysical problems. J. E. K.

5318. Intensities in Atomic Spectra. M. H. Johnson, Jr. *Nat. Acad. Sci., Proc.* 19. *pp.* 916–921, *Oct.,* 1933.—In the theory of complex spectra a number of methods have been developed for calculating the relative energies of the states arising from an electronic configuration. In this work a study is made of the matrix of the electric moment whose components determine the intensity of the lines radiated by the atom. The problem is considered under two heads : (1) the determination of the electric moment in a definite coupling scheme ; (2) the electric moment matrix in intermediate coupling. The procedure for determining the latter from the former is quite straightforward and is illustrated by an example. A. H.

5319. Relative Intensity Tables for Spectrum Lines. H. E. White and A. Y. Eliason. *Phys. Rev.* 44. *pp.* 753–756, *Nov.* 1, 1933.—Relative intensities for a large number of multiplets have been calculated from well-known theoretical formulæ. These intensities have been tabulated for future reference in making analyses of spectra. The tables are grouped under each resultant spin, from singlets $S = 0$, to octets $S = 7/2$ and include all probable values of L and J. It is shown how the same tables apply to *jj*-coupling, to hyperfine structure, and to related multiplets. AUTHORS.

5320. Hyperfine Structure Intensities of the 2^3S_1–$2^3P_{0,1,2}$ Triplet in Optically Excited Mercury Vapour. M. L. Pool and S. J. Simmons. *Phys. Rev.* 44. *pp.* 744–747, *Nov.* 1, 1933.—The hyperfine structures of the mercury lines 5461, 4358 and 4047 in fluorescence emission were obtained in the second order of a 30,000 line, 21-ft. grating. The ratio of the intensity of the central component to the intensity of any one of the other components was found greater than a similar ratio for the emission from the exciting arc. This anomalous increase in intensity of the central component in fluorescence may be accounted for by making use of the absorption coefficients of the components of 4047. AUTHORS.

5321. Inversion of Doublets in Alkali-Like Spectra. Melba Phillips. *Phys. Rev.* 44. *pp.* 644–650, *Oct.* 15, 1933.—Many of the doublets in the spectra of alkalies and alkali-like ions are inverted or anomalously narrow. This " tendency to inversion " may be explained by the polarisability of the core, which may be formulated as the repulsion by the excited core configuration states of the levels of the optical doublet. A study is made of the energies and wave functions of these states for the spectra Na I to S VI, on two coupling schemes which allow approximate computations to be made. On the assumption of *LS* coupling the separations of the excited core doublets turn out to be of the order of magnitude of the $2p$ X-ray doublet; half the excited core doublets are inverted and half of them normal. The two sets of doublets repel the levels of the optical doublet unequally, and, in the series of spectra considered, the differential repulsion is of the right sign to give an inverting tendency of the same order, though somewhat less, than the observed inversion. The same problem is then treated by another approximation, by assuming the $2p$ X-ray doublet energy large compared to the electrostatic interaction energy of the $3p$ and $3d$ electrons. The results with both models are proportional to the spin orbit interaction energy of the " hole " in the $2p$ shell. The condition that the effects studied should tend to invert and not to broaden the optical doublets, and the further conditions that they should produce an actual inversion are considered. In most cases these questions may be answered from a consideration of the quantum numbers associated with the states capable of perturbing the doublet, and the ratio of optical and X-ray doublet separations. In this way we can understand the observed incidence, both of the tendency toward inversion and of the inversion itself. AUTHOR.

5322. Characteristic Values of the Two Minima Problem and Quantum Defects of *f* States of Heavy Atoms. Ta-You Wu. *Phys. Rev.* **44.** *pp.* **727–731,** *Nov.* **1, 1933.**—The characteristic value problem with two unequal minima in the potential field has been solved by the approximate method of Wentzel, Kramers and Brillouin. The result is applied to the calculation of the quantum defects of the *f* states of heavy atoms and explains the fact that these quantum defects are all very close to unity. AUTHOR.

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5323. Configuration Interaction in Complex Spectra. C. W. Ufford. *Phys. Rev.* **44.** *pp.* **732–739,** *Nov.* **1, 1933.**—The electrostatic interaction is calculated between the terms in Russell-Saunders coupling of the electron configurations $nd^2n's$, nd^3, $ndn's^2$ and $nd^2n''s$. The first order eigenfunctions, for the terms of these configurations in the LSM_LM_S scheme with $M_L = 0$, $M_S = \frac{1}{2}$ are given in terms of the zero order functions of Slater. The matrix elements between the quartets of d^2s and d^3 are found to vanish. The sums over closed shells in non-diagonal matrix elements of electrostatic interaction are found to vanish except when the two electrons not in closed shells have the same value of l. This sum is evaluated in general and for the configurations $nd^2n's$–$nd^2n''s$. The matrix elements of magnetic spin orbit interaction are given between the initial states without configuration interaction. The electrostatic energies and magnetic splittings are then calculated for the terms of $nd^2n's$, nd^3 and $ndn's^2$; and compared with the values observed in Ti II and Zr II. Zr II agrees particularly well, especially if the observed ^2D terms are rearranged. AUTHOR.

5324. Relative Multiplet Transition Probabilities from Spectroscopic Stability. E. U. Condon and C. W. Ufford. *Phys. Rev.* **44.** *pp.* **740–743,** *Nov.* **1, 1933.**—A method analogous to the diagonal sum rule for term values is given for calculating the relative transition probabilities of the different multiplets in Russell-Saunders coupling. The method is based on the principle of spectroscopic stability. The relative multiplet transition probabilities are given for the transitions p^2d-p^3, d^2p-d^3, p^3d-p^4 and p^4d-p^5. AUTHORS.

5325. Energy Levels of the Rare-Gas Configurations. G. H. Shortley. *Phys. Rev.* 44. *pp.* 666–674, *Oct.* 15, 1933.—The secular equations expressing the electrostatic and spin-orbit interactions of the configurations p^5p and p^5d are found to be very conveniently handled if one neglects the interaction between levels which have different levels of the ionic doublet as parents, an approximation significant for all but the lowest p^5p's of neon and argon. The 10 levels of p^5p and the 12 of p^5d are each expressed in terms of six parameters, one of which corresponds directly to the ionic doublet splitting. It is found that the higher members of the p^5p series in neon and argon, the lowest configurations of this type in krypton and xenon, and all eight members of the neon p^5d series agree with these formulas to within the magnitude of the above-mentioned neglected interaction (which becomes relatively very small for the higher series members) in all cases where two configurations do not obviously strongly perturb each other. Because of the generally very weak interaction between configurations in these spectra, better agreement between theory and observed data is found than has been the case for any other atoms. This calculation gives the eigenstates for these configurations exact specification in the *jj*-coupling scheme. AUTHOR.

5326. Energy Levels of the Hydrogen Molecular Ion. C. Gilbert. *Phil. Mag.* 16. *pp.* 929–944, *Nov.*, 1933.—The differences between the most recent calculations of the energy levels of the hydrogen molecular ion are discussed, with special reference to the degeneracy of symmetric and antisymmetric states. A perturbation theory is given and results calculated which are in close agreement with those obtained by the variation method. A method is also stated whereby the higher energy levels can be easily obtained, and curves are drawn for the energy levels up to the second excited states of the hydrogen molecular ion. The lower energy levels compare favourably with those obtained by the more exact variation method. No published results of experiment appear to give sufficiently large moments of inertia to be in agreement with the theoretical values for the excited H_2^+ molecule. AUTHOR.

5327. Band Emission of Carbon Dioxide. R. Schmid. *Zeits. f. Physik*, 85. 5–6. *pp.* 384–388, *Sept.* 14, 1933.—Photographs were taken in the 5th order of a 21-ft. grating, using suitable filters. The bands are shown to be simply formed and degraded to the red. It is probable that with sufficient resolution all lines would show staggering and duplicity. F. S.

5328. Spectrum of Sulphur Dioxide. Tung-Ching Chow. *Phys. Rev.* 44. *pp.* 638–643, *Oct.* 15, 1933.—A study has been made of the emission and absorption spectrum of sulphur dioxide with special emphasis on the region from 2000 to 2600 Å. It was found possible to run a discharge in flowing SO_2 with comparatively little dissociation. The work on absorption was supplementary to that on emission and carried out at the same moderate dispersion. A large proportion of both the emission and absorption bands found fit into a scheme of vibrational levels. The upper levels indicate a frequency of about 375 cm^{-1}. or an integral multiple of that value. The lower levels confirm the 1150 and 520 frequencies previously observed but leave the third frequency in doubt. The $x_e\omega_e$ for both the 1150 and 520 frequencies are small, of the order of one cm^{-1}. for the latter as determined from a progression of sixteen bands. AUTHOR.

5329. New O_2^+ Bands. Dissociation Energy of O_2^+ and Ionisation Potential of O_2. R. S. Mulliken and D. S. Stevens. *Phys. Rev.* **44.** *pp.* 720–723, *Nov.* 1, **1933.**—Three new bands are reported in the first negative and several in the second negative system of O_2^+. The numbering of the vibrational levels of the normal state of O_2^+, hitherto in doubt, is definitely established. The observed ionisation potentials I of O_2 at 12·5 and 16·1 volts are discussed. From the known O_2^+ energy levels it is shown that the dissociation energy D of O_2^+ cannot be less than 6·0 volts; by extrapolation from the known levels we get 6·54 volts. The latter value, however, would require 12·11 volts as the ionisation potential of O_2. We suggest $D = 6{\cdot}45 \pm 0{\cdot}1$ and $I = 12{\cdot}2 \pm 0{\cdot}1$ volt as a reasonable compromise (making D and I consistent, as they must be in reality) between the ionisation potential and band spectrum data.
AUTHORS.

5330. Infra-Red Absorption of Benzene Vapour. R. Titeica. *Soc. Romåne Fiz., Bul.* 35. *pp.* 89–92, *June–July,* 1933. *In French.*—The absorption bands of benzene vapour betwen 2μ and 17μ are observed to fall at the same wave-lengths as those of the liquid, but the relative intensities are different. An attempt is made to calculate the fundamental frequencies, and the results are compared with the values observed in the liquid and vapour, and in the fluorescence and Raman spectra. A band at 3060 cm^{-1}. is attributed to a C – H vibration, and Mecke's formula gives the internuclear distance 1·04 Å for this bond. Frequencies at 1036 and 1583 cm^{-1}. are also attributed to C – C and C = C respectively, both linkages thus being present in the molecule simultaneously. The moment of inertia of the molecule about an axis in its plane is 14×10^{-39} $gm.cm^2$.
C. B. A.

5331. Infra-Red Absorption Spectra of Benzene Derivatives. R. Freymann and A. Naherniac. *Comptes Rendus,* 197. *pp.* 829–831, *Oct.* 16, 1933.—Study of the absorption spectrum of benzene in the near infra-red by means of a recording spectrometer [see Abstract 844 (1932)] reveals, in addition to the very intense bands at 0·87 and 1·14μ, a weak band at 1μ, which is attributed to the C – H linkage. The influence of electro-negative substituents on the strong bands of benzene is studied.
C. B. A.

5332. Near Infra-Red Absorption Bands. R. Freymann. *Ann. de Physique,* 20. *pp.* 243–345, *Oct.,* 1933.—A large number of absorption bands of organic liquids in the region 0·84 — 1·16μ were investigated. A thalofide cell with amplifier was used as detector, and its high sensitivity enabled a grating to be used with narrow slits transmitting a band of only 3 Å width. Some bands not previously recorded were found but the main object of the investigations was to determine the effect of various molecular changes on the positions and intensities of absorption bands characteristic of certain groups, *viz.*, (CH), (CH =), (C = C), (OH) and (NH). The differences between the bands in members of a homologous series and in isomers were studied; also the changes caused by the introduction of double linkages, by the substitution of different groups (C_6H_5 for example), by temperature changes and by dilution in various solvents. The effect of the presence of these absorption bands on the natural rotatory power of various substances was investigated. D. H. F.

5333. Character of Bonds in Hydrogen Halides as Found by Absolute Intensity Measurements of the Infra-Red Primary Bands. E. Bartholomé. *Zeits. f. phys. Chem.* 23. *Abt.B.* 1–2. *pp.* 131–151, *Oct.*, 1933.—A method has been developed which enables the determination of the absolute intensities of infra-red absorption bands. The basic conception is to increase the pressure of an added gas so that the fine structure of the absorbing gas disappears in consequence of the broadening of the rotation lines. The primary bands of hydrochloric, hydrobromic and hydriodic acids have thereby been measured, and afford for the transition probability B^1_0 the values $1·93 \times 10^{15}$, $1·67 \times 10^{15}$ and $0·35 \times 10^{15}$, and for the effective charge ϵ the values 0·086 e, 0·075 e and 0·033 e, where e is the elementary charge. It is shown that these small values of e are only compatible with a homopolar bond in the hydrogen halides. H. H. Ho.

5334. Infra-Red Spectrum of Propane and Diacetylene. E. Bartholomé. *Zeits. f. phys. Chem.* 23. *Abt.B.* 1–2. *pp.* 152–157, *Oct.*, 1933.—A description is given of the infra-red spectra of propane and diacetylene together with the Raman spectra. From a discussion of the results it is concluded that diacetylene possesses a linear atomic arrangement. H. H. Ho.

5335. Spectral Differentiation of Pure Hydrocarbons: Near Infra-Red Absorption Study. U. Liddel and C. Kasper. *Bureau of Standards, J. of Research,* 4. *pp.* 599–618, *Nov.*, 1933.—The spectra of 36 hydrocarbons have been recorded in the near infra-red from 5500 to 9000 cm^{-1}. (1μ to 2μ), using an automatic recording infra-red glass spectrograph. Specific absorptive indices have been calculated from the results and plotted against wave numbers (wave-lengths per cm.). Correlations of the spectra of the various compounds have been made in regions associated with three energy transitions in the molecules. Characteristic differentiation of the compounds according to structural types has been indicated. AUTHORS.

5336. Infra-Red Absorption Spectra of Plant Pigments. R. Stair and W. W. Coblentz. *Bureau of Standards, J. of Research,* 11. *pp.* 703–711, *Nov.*, 1933.—An important study of the properties of matter is the effect of chemical constitution upon the spectral absorption of a substance. The present contribution to this subject pertains to the infra-red spectrum, extending to about 15μ. A description is given of the absorption spectra, to about 15μ in the infra-red, of the following plant pigments and derivatives: chlorophyll, carotin, xanthophyll, ethyl chlorophyllide, phytol, pheophytin, and copper pheophytin. The data were obtained by means of a mirror spectrometer, vacuum thermopile and ion-clad Thomson galvanometer described in previous publications. Changes in the absorption spectrum of carotin, accompanying oxidation, are described. In general, the results are similar to those observed on the highly-coloured aniline dyes, in which there is an intense, wide absorption band in the short wave-lengths, and the infra-red absorption spectrum is composed of numerous small absorption bands, in contrast with substances having a simpler chemical structure, in which the absorption bands are less numerous, more intense, and more sharply defined. AUTHORS.

5337. Change in the Absorption Spectrum of Cobalt Chloride in Aqueous Solution with Increasing Concentration of Hydrochloric Acid. O. R. Howell and A. Jackson. *Roy. Soc., Proc.* **142.** *pp.* **587–597,** *Nov.* **1, 1933.**—Absorption spectra of solutions containing a fixed amount of $CoCl_2,6H_2O$ but with increasing concentration of HCl have been measured. The curves of extinction coefficients at the maxima of the four principal bands at 6950, 6660, 6260 and 6100 Å plotted against concentration show that no blue constituent is formed below a critical concentration (5*N*) of acid. Above this concentration, the amount increases, and (for the 6950 and 6660 bands) a linear relationship holds between 7·1 and 9·0*N* acid. At these three concentrations the ratio of Cl atoms to H_2O molecules is 2 : 3 : 4. A mechanism for the change $[Co(H_2O)_6]^{\cdot\cdot}$ (red) → $[CoCl_4]^{\cdot\cdot}$ (blue) with two intermediate stages is suggested. The state of the cobalt atom is independent of its concentration relative to the other constituents. Differences in the behaviour of the absorption bands with increasing concentration enable them to be attributed to principal or auxiliary valencies. C. B. A.

5338. Intensity Measurements on the Band Spectrum of Helium. R. C. Johnson and R. C. Turner. *Roy. Soc., Proc.* **142.** *pp.* **574–587,** *Nov.* **1, 1933.**—Line intensity measurements on the first five members, λλ 4650, 3676, 3356, 3206 and 3120, of the main line series of Helium bands are given. The predicted distribution is of the correct type, but agreement with observation is not complete. Notably the P and R branches are much stronger, relative to the Q branch, than the theory indicates. An expression of the form $ie^{-E/kT}$ where "*i*" is a linear function of J^1, is sufficient to describe the observed distribution. As with many other bands, the temperatures obtained by assuming Maxwell-Boltzmann distribution are much higher than the true temperature of the source. A temperature of approximately 750° A. is found for all the bands. The temperatures obtained from intensity factor considerations are in close agreement with the values found from the position of the maximum intensity in the branches. The fall of intensity down the series is examined and it is found that the relative intensities of the bands are given by a formula which is similar in some respects to that found by Bongers for the Balmer Series. AUTHORS.

5339. Continuum in the Emission Spectrum of Potassium Hydride. T. Hori. *Ryojun Coll. Eng., Mem.* **6.** *pp.* **115–127,** *Aug.,* **1933.**—A potassium arc in hydrogen gives, on the short-wave side of the $^1\Sigma - {}^1\Sigma$ band system, a continuum with maxima and minima of intensity [see Abstract 3023 (1933)]. A theoretical interpretation of this continuum is proposed in the light of the Franck-Condon principle in wave-mechanical form. It is supposed that the transition concerned is between an unstable $^1\Pi$ state and the $^1\Sigma$ ground state. Thus the approach of a normal H-atom to an excited K-atom corresponds to a point on the repulsion curve of the $^1\Pi$ state, and the system can pass over into the different vibrational states of the ground state with emission of the continuum. Assuming thermodynamic equilibrium in the $^1\Pi$ state, a formula is given for the intensity of the emission, and a repulsion curve is constructed of such a form as to give the best possible agreement with the observed intensity distribution in the continuum. A similar continuum with maxima and minima is also observed for NaH, but the intensity is much smaller. In the case of LiH no such continuum is found. L. A. W.

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5340. Analysis of Zeeman Patterns. R. A. Fisher. *Phys. Rev.* 44. *pp.* 724–726, *Nov.* 1, 1933.—A method for the representation and analysis of Zeeman patterns is explained. The method makes possible the representation in a simple graphical manner of the line distribution, intensities, polarisation and *g*-values for Zeeman patterns occurring in all types of spectra. When applied to observed patterns the method offers a means of identification and analysis even if the patterns are imperfectly resolved. AUTHOR.

5341. Paschen-Back Effects in the Spectra of Thallium. A. M. Crooker. *Phil. Mag.* 16. *pp.* 994–1005, *Nov.*, 1933.—The Paschen-Back effect of several visible thallium lines has been investigated at a field strength of 25·3 kilogauss in the second order of a three metre concave grating. The complex patterns obtained are shown to agree well, within the limits of experimental error, with the theoretical ones deduced from the intermediate field equations of Goudsmit and Bacher. AUTHOR.

5342. Raman Effect of Sulphuric Acid. L. Médard. *Comptes Rendus*, 197. *pp.* 582–584, *Sept.* 4, 1933.—If the purest sulphuric acid of commerce, which is fluorescent in mercury vapour lamp radiation, is heated with a trace of $KMnO_4$ at 150° C. the fluorescence disappears; the latter is thus due to organic impurities. The Raman spectrum of acid (100 %) purified in this manner is described. It differs from that of less concentrated acid in that the line at 1050 cm^{-1}. is absent, a weak line appears at 975 cm^{-1}., and the line at 415 cm^{-1}. is seen to have two components, at 391 (n_1) and 437 (n_2) cm^{-1}. Addition of water to the concentrated acid causes a weakening of n_1, which broadens and approaches n_2; with 96 % acid the two appear as a band having two maxima. The line at 975 cm^{-1}. does not appear with acid less concentrated than 95 %. The lines at 990 and 1050 cm^{-1}. are attributed to free SO_4 ions and HSO_4 ions, respectively, whilst those at 430 and 565–600 cm^{-1}. are attributed to bound SO_4 ions. Other lines observed only in highly concentrated acid are ascribed to $SO_2(OH)_2$ groups. H. F. G.

5343. Raman Effect in Nitric Acid. L. Médard and H. Volkringer. *Comptes Rendus*, 197. *pp.* 833–836, *Oct.* 16, 1933.—The Raman spectrum of 99·8 % HNO_3 has been measured and gives values for the characteristic frequencies which are in good agreement with those obtained by Dadieu and Kohlrausch, but no frequency at 3420 cm^{-1}. is now observed. Dilution of the acid with water is found to affect both intensity and position of these frequencies. Solutions of nitric acid in chloroform give the superposed spectra of the components, but the intensities of all the frequencies diminish with decreasing concentration of acid, indicating normal solution, whereas in water the inactive frequency of the NO_3 ion at 1048 cm^{-1}. increased in intensity as that of the other frequencies decreased with decreasing concentration. C. B. A.

5344. Depolarisation of the Raman Lines of Liquids. L. S. Ornstein and P. Stoutenbeek. *Zeits. f. Physik*, 85. 11–12. *pp.* 754–760, *Oct.* 14, 1933.—The degrees of depolarisation of the Raman lines of carbon tetrachloride are determined with the "ideal" arrangement, *i.e.*, with well defined directions of illumination and observation. The results obtained, which are in agreement with those of Cabannes, are then used to calibrate an arrangement of the much more luminous Wood type, with

a view to using this for depolarisation measurements by the method originally devised by Placzek and van Wijk [see Abstract 2309 (1931)]. The paper concludes with some results for $C_2H_4Cl_2$ obtained in this way.
L. A. W.

5345. Line Shape as a Function of the Mode of Spectrograph Slit Irradiation. D. C. Stockbarger and L. Burns. *J.O.S.A.* 23. *pp.* 379–385, *Nov.*, 1933.—Some of the more common modes of spectrograph slit irradiation have been studied experimentally. Particular attention has been paid to line shape and its effect on resolution. The noncoherent mode is seldom if ever employed because of practical limitations. The lens and broad source modes offer a means of realising high flux transmission, but the consequent line resolution may be poor. The resolution can be improved by reducing either the relative aperture of the condenser lens or the angle subtended by the broad source at the slit. The limit in either case is the coherent mode with which very sharp, well-resolved lines can be obtained. The closest approach to flat top line shape is realised through the use of a wide slit when the departure from noncoherent irradiation is not very great. AUTHORS.

5346. Short Wave Oscillator for Spectroscopy. H. Pettersson. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 7. *pp.* 325–328, 1933.—A simple short wave oscillator is described which powerfully excites gas discharge tubes of capillary form. The oscillations are of 7 to 18 m. wave-length and the tubes can be used with external electrodes or simply placed along the axis of the coils and excited by induction. Some of the chemical and physical effects produced in gases under such excitation are described.
D. H. F.

See also Abstracts 5105, 5275, 5289, 5292, 5370, 5402, 5403, 5405.

VISION.

5347. Complementary Colour Relations. E. Genberg. *Phys. Soc., Proc.* 45. *pp.* 836–840, *Nov.* 1, 1933.—The author has determined pairs of wave-lengths which are complementary with respect to equi-energy radiation taken as white. The energy and luminosity of one of the complementaries for unit luminosity of the white are given. AUTHOR.

5348. Neutral Value Scales. Part I. Munsell Neutral Value Scale. A. E. O. Munsell, L. L. Sloan and I. H. Godlove. *J.O.S.A.* 23. *pp.* 394–411, *Nov.*, 1933.—The possible basis for significant value scale of reflectances, for surfaces ranging from 0 % to 100 % reflectance, is discussed and a review of previous work given. Experiments are then described which determine the "just noticeable differences" under specified conditions for given reflections for a number of observers and a value scale is deduced. Ordering of the values of a series of stepped reflectances provides a second method for determining a value scale under conditions similar to the first. The two methods are compared and found to give a good agreement. W. D. W.

X-RAYS.

5349. Progress in the Design and Manufacture of X-Ray Tubes. M. J. Gross and Z. J. Atlee. *Radiology*, 21. *pp.* 365–377, *Oct.*, 1933.—Describes the production of modern X-ray tubes in the G.E.C. works. Design is dealt with in respect to the physical dimensions, as affected by the tube voltage and, particularly, in respect to the shape of the tube bulb, the advantages and disadvantages of the spherical and cylindrical tube envelope being discussed. In the cylindrical tube the outer coat of lead, provided for X-ray protection, also, by a condenser effect, serves to prevent undue electrostatic stress and so to prevent puncture. The spacing of the electrodes is considered as concerns too near and too far spacing. Of recent years more perfect glass has been obtained for the tube envelope and much work carried out in the application of borosilicate hard glass, which has higher melting point, greater mechanical strength and higher electrical resistivity than soft glasses hitherto used. Dimensioning of the glass thickness is discussed, particularly with respect to grinding of thin windows, for more effective X-ray penetration. Fluorescence of the glass is dealt with and the effects of residual gas, as a cause of ionisation. Design of the focal spot of the anode as regards shape and size is illustrated by experimental data. Cooling the focal spot by rotation of the anode, is stated to be mechanically complicated and, at the present day, limited in application. Design of the kathode and difficulties of design are briefly dealt with. A second part of the paper deals with the assembly of the tube components and later exhaustion and, in respect to the latter, the X-ray tube, before sealing, is now heated by the use of h.f. energy. In the manufacture of tubes the ionisation gauge and mercury shut-off play a most important part and these are described. B. J. L.

5350. Influence of Chemical Combination on Absorption Coefficients of Light Elements for Long Wave-Length X-Rays. R. H. Messner. *Zeits. f. Physik*, 85. 11–12. *pp.* 727–740, *Oct.* 14, 1933.—The absorption coefficients of H_2, CH_4, C_2H_2, C_2H_4, C_2H_6, C_3H_8, N_2, O_2 CO, CO_2, and air for the carbon Kα and boron Kα wave-lengths ($\lambda = 44\cdot5$ Å and 68 Å respectively) are determined. A vacuum spectrograph with a counting device for the measurement of X-ray intensity is employed and the results are accurate to 1 %. Except in the case of hydrogen the Z^4 and $\lambda^{2.5}$ absorption law is found to hold for these wave-lengths. In the case of hydrogen the exponent of λ is distinctly higher. J. T.

5351. Reflection of X-Rays by Absorbing Crystals. M. Kohler. *Ann. d. Physik*, 18. 3. *pp.* 265–287, *Oct.* 1933.—A general theoretical discussion of X-ray reflection by absorbing and non-absorbing crystals is given, based upon the dynamical theory of X-ray interference. The particular case of the reflection of tungsten $L\beta_1$ by ZnS is investigated, some simplifying assumptions being introduced. The structure factor of ZnS is calculated and found to agree with the results of experiment. The intensity distribution in the radiation reflected from absorbing crystals is shown to be unsymmetrical with respect to the Bragg angle as corrected by Ewald. In the case of the reflection of tungsten $L\beta_1$ by ZnS, the Ewald correction should be reduced by about 30 %. J. E. R. C.

5352. Reflection of X-Rays from Anthracene Crystals. B. W. Robinson. *Roy. Soc., Proc.* 142. *pp.* 422–447, *Nov.* 1, 1933.—The absolute intensity of reflection of X-rays from anthracene crystals for the (001) planes has been measured for two wave-lengths ($\lambda = 1\cdot539$ Å and $\lambda = 0\cdot709$ Å), using small crystals up to 0·5 mg. in weight, bathed in a uniform monochromatic beam. The intensity measurements were made with a recording ionisation spectrometer using valve amplification, which is described. Errors due to non-monochromatism of the beam and to extinction and absorption in the crystal are investigated, and a method of applying the extinction correction to small crystals is developed. The final values of the structure factor F for the (001) planes are 30·5 and 32·8 respectively for the two radiations; and the significance, if any, of this difference is discussed. The values found may be used for the determination by comparison of absolute values for other organic crystals, thus avoiding the labour of making absolute measurements afresh in each case. AUTHOR.

5353. Refraction of X-Rays by Glass. G. Orbán. *Zeits. f. Physik*, 85. 11–12. *pp*. 741–753, *Oct*. 14, 1933.—The existence of a real refracted wave in the region of so-called total reflection and the dependence of the refractive index of X-rays upon the angle of incidence are considered theoretically. In the experimental part a description is given of a new method of investigating the reflection and refraction of X-rays, using a fixed prism and varying the direction of the incident beam. Measurements are made with a wave-length of 1·54 Å over a range of glancing angles from 16′ 54″ to 4°, corresponding to deviations from 519″ to 26·1″. Over this range the refractive index n is found to be constant, it being impracticable to extend the experiments to the range in which variation of n are predicted. The actual value obtained for $1 - n$, *viz*., $8{\cdot}83 \pm 0{\cdot}02 \,.\, 10^{-6}$, is about 10 % higher than that calculated from the classical theory of dispersion. L. A. W.

5354. Quadripolar Radiation. L. Pincherle. *N. Cimento*, 10. *pp*. 205–210, *May*, 1933.—Establishes theoretical relations between the intensities of certain lines due to quadripolar X-radiation with those of the ordinary lines due to dipolar X-radiation. A. D.

5355. X-Ray Emission Spectra of Gaseous Elements. K-Spectrum of Xenon (Emission and Absorption). H. Hulubei and (Miss) Y. Cauchois. *Comptes Rendus*, 197. *pp*. 644–646, *Sept*. 25, 1933.—Using the authors' method slightly modified so as to require less gas, with Ce, La, Cs, and I as reference elements, $K\alpha_2$, $K\alpha_1$, $K\beta_1$, and $K\beta_2$ are respectively 419·58, 415·12, 367·72 and 359·16 X.U.; and the critical absorption limit for K is 357·77 X.U. [See Abstracts 3648 and 3649 (1933).] C. A. S.

5356. Characteristic X-Ray Emission of Gaseous Elements. Weak Lines in the K-Spectrum of Krypton. (Miss) Y. Cauchois. and H. Hulubei. *Comptes Rendus*, 197. *pp*. 681–682, *Oct*. 2, 1933.—Weak lines have been observed in the K-spectrum of krypton and assigned to transitions as follows: β_4, KN_{IV-V} (forbidden); β_5, KM_{IV-V} (forbidden); β_0 (long wave-length satellite of β_1), KM_1 (doubly forbidden). The wave-lengths of these and of $K\beta_2$, $K\beta_1$, and $K\beta_3$ are recorded. A spark line, which is considered to be analogous to that observed by Ross in elements 42–47, is also observed. [See Abstracts 3648 and 3649 (1933).] C. B. A.

5357. X-Ray Satellites of High Atomic Number Elements. F. K. Richtmyer and S. Kaufman. *Phys. Rev*. 44. *pp*. 605–609, *Oct*. 15, 1933.—The X-ray lines $L\alpha_1$ and $L\alpha_2$ have been examined for accompanying satellites in the atomic number range from Ta(73) to U(92). $L\alpha$ is found to have two satellites, herein called $L\alpha^{ix}$ and $L\alpha^{x}$. The former (longer wave-length) extends from Au(79) to U(92); the latter from Os(76) to Bi(83). Even over the short range of atomic numbers over which they occur, these two satellites change rapidly as to relative intensity and appearance. They do not seem to be connected with the prominent group of satellites of $L\alpha$ which occur in the region $36 < Z < 54$. $L\beta_2$ is found to have two satellites, $L\beta_2'$ and $L\beta_2''$. $L\beta_2''$ extends from Ta(73) to U(92). $L\beta_2'$ begins several atomic numbers below Ta(73) and extends to U(92). The satellite structure accompanying $L\beta_2$ in this high atomic number range is somewhat similar to that found in the range $40 < Z < 54$. But the absence of any satellites of $L\beta_2$ in the range $54 < Z < 70$ suggests that these high atomic number satellites may be new lines. AUTHORS.

5358. Soft X-Rays from (100) and (111) Faces of Copper Single Crystals. M. L. Williams. *Phys. Rev.* 44. *pp.* 610–617, *Oct.* 15, 1933.—Between 90 and 220 volts 14 critical potentials were found for both the (111) and the (100) faces. Each break is the same within 1·5 volts for the two targets. Agreement with published results for polycrystalline copper is fair, although there are fewer discontinuities than for the metal, as in other experiments with single crystals. The critical potentials may be grouped to show level differences, attributed by Richardson to structure electrons in the crystal lattice. Comparison with other results for metals of similar structure casts doubt on this theory. Kronig's theoretical interpretation of fine structure in X-ray absorption presents a possible explanation of soft X-ray critical potentials. Assuming 4 to 7 volts inner potential, 10 of the 14 observed critical potentials agree with Kronig's calculated energy discontinuities and only one calculated discontinuity was not observed. A strong break at 104 volts, not predicted by this theory, is within 2 volts of Kurth's value for the *N* series convergence frequency. Similar good agreement exists between Thomas' critical potentials for polycrystalline iron and nickel and the energy discontinuities calculated from Kronig's theory. From these results it appears that the theory of forbidden energy zones may account for soft X-ray critical potentials. AUTHOR.

5359. Widths and Shapes of the $K\alpha$ X-Ray Doublet from Ca (20) to Ni (28). L. G. Parratt. *Phys. Rev.* 44. *pp.* 695–702, *Nov.* 1, 1933.—The rocking curves of the $K\alpha$ X-ray doublet of elements Ca(20) to Ni(28) have been recorded with a vacuum double-crystal spectrometer, and measurements of the full widths at half maximum intensity, relative intensities, asymmetry and degree of resolution have been made. Resolution of the observed overlapping curves into the two component lines α_1 and α_2, has been attempted. The relative intensity of the doublet lines α_1 to α_2 if defined in terms of the double-crystal spectrometer as the ratio of areas under the component curves, is 2 to 1 for all elements studied within an estimated error of ± 2 %. The asymmetry of the lines is found to increase from Ca to Fe, then to decrease with increasing atomic number. The values of the full widths, uncorrected for divergence and for the finite resolving power of the crystals, of the component lines, in X.U., follow :

	Ca	Ti	Va	Cr	Mn	Fe	Ni
$K\alpha_1$ –	1·60	1·22	1·15	1·08	1·10	1·02	0·72
$K\alpha_2$ –	1·54	1·43	1·35	1·30	1·22	1·12	0·88

The ratio of peak intensities is observed to vary from element to element in such a way as to compensate for the variations in line widths so that the ratio of component areas remains constant. AUTHOR.

See also Abstracts 5130, 5133.

HEAT.

CALORIMETRY.

5360. Heat Capacities of Cis- and Trans-Dichloroethylenes. A. R. Olson and F. W. Brittain. *Am. Chem. Soc., J.* 55. *pp.* 4063–4068, *Oct.*, 1933.—The heat capacities were determined by a method which consists in measuring the wave-length of h.f. sound waves in the gas when placed between a quartz crystal source of waves and a reflector. The velocity of sound in either gas varies almost rectilinearly from 171 m./sec. at 20° C. to 227 m./sec. at 230° C. and the data agree with the assumption that C_v is the same for both gases and is constant over the whole range of temperature, with an average value of $12\cdot14 \pm 0\cdot26$ calories per mole. Objections to the use of the acoustic method [see Abstract 4422 (1932)] do not apply in the present case. G. E. A.

5361. Variability of Specific Heat of Fused and Solidified Silver. F. M. Jaeger, E. Rosenbohm and W. A. Veenstra. *K. Akad. Amsterdam, Proc.* 36. 3. *pp.* 291–298, 1933.—The specific heat of silver which has been cast in air differs from that which has been cast *in vacuo*, the former being the higher. This is considered to be connected with the absorption of oxygen by heated silver. L. G. C.

See also Abstract 5374.

CONDUCTION.

5362. Transition from Wave Equation to Heat Conduction Equation. W. Tschen. *Göttingen Nachrichten, Math-Phys. Klasse, No.* 3. *pp.* 365–370, 1933.—A mathematical treatment of the transition from differential equations in " wave " form to those in " diffusion " form. J. H. A.

5363. Energy Exchange between Inert Gas Atoms and Solid Surface. J. M. Jackson and A. Howarth. *Roy. Soc., Proc.* 142. *pp.* 447–456, *Nov.* 1, 1933.—The theory of the thermal accommodation coefficient previously given by Jackson and Mott [see Abstract 5081 (1932)] for a one-dimensional exponential field is extended by averaging over the normal modes of vibration of the solid. Good agreement is obtained with the experiments of Roberts on temperature variation of the accommodation coefficient of helium on tungsten for the value 4×10^8 cm^{-1}. of the exponential index a. This is of the same order of magnitude as that suggested by the work of Born and Slater. AUTHORS.

5364. Exchange of Energy between Gas Atoms and Solid Surfaces. Part III. Accommodation Coefficient of Neon. J. K. Roberts. *Roy. Soc., Proc.* 142. *pp.* 518–524, *Nov.* 1, 1933.—The accommodation coefficient of neon with a tungsten surface free from adsorbed films has been measured and found to be $0\cdot07$ at 295° K. and to vary very little with temperature down to 79° K. The value obtained with an ordinary surface covered with adsorbed films is $0\cdot6$. From the accurate one-dimensional theory of Jackson and Mott and these results it is possible to draw the following conclusions : (1) from the ratio of the accommodation coefficients at room-temperature of helium and neon the repulsive forces between tungsten atoms and the gas atoms are not similar to the forces between elastic spheres; (2) if the potential energy due to the repulsive force between a tungsten atom in the solid and a neon atom at a distance r is given by $Ce^{-\lambda r}$, where C and λ are constants, λ is not greater than 5 or $6 \cdot 10^8$ cm^{-1}. The experimental results are compared with an approximate theory taking into account the attraction between the solid and the gas atoms and it is shown that the results enable us to choose within limits the repulsive and attractive force constants, and it is pointed out that we need a more accurate theory of the effect of attractive forces in order to obtain from the experimental results reliable values for these constants. [For Part II see Abstract 2478 (1932).] AUTHOR.

See also Abstract 5367.

CONVECTION.

See Abstract 5230.

DILATATION.

5365. Behaviour of Glass when Slowly Heated with Special Reference to the Thermal Expansion. E. Seddon and W. E. S. Turner. *Soc. Glass Technol., J.* 17. *pp.* 324–347, *Sept.*, 1933.—Measurements of the thermal expansion from room temperature to the softening point have been made on seven glasses differing widely in composition, viscosity and other properties. Observations were made on specimens of standard length and approximately the same diameter when heated at the rate of 1° per min. throughout the range and also when heated at the rate of ⅛° per min. Comparisons in the expansion, the transformation point and the softening point are given. Transition points on the thermal expansion curve were more noticeable at the slow rate of heating than at the faster rate and in several glasses heat absorption effects caused retrogression in the curve just below the transformation point. It is concluded that whilst the determinations at very slow rates of heating are of special interest in studying the constitution of glass, there is no need for practical purposes for a specimen of 5 mm. thickness to be heated at a rate slower than 1° per min. W. D. W.

5366. Thermal Expansion of Silica-Soda-Beryllia Glasses. E. Rencker. *Comptes Rendus*, 197. *pp.* 840–843, *Oct.* 16. 1933.—An outline of the preparation of the glasses is given and curves are shown illustrating the effect of the glass composition on the temperature of transformation and on the coefficient of expansion. It is found that the replacement of the soda or the silica by the beryllia raises the transformation temperature, substitution of the soda by the beryllia reduces the coefficient of expansion, but that replacing silica by beryllia makes no appreciable difference in the expansion. W. D. W.

5367. Physical Properties of Glasses of the $SiO_2 - Na_2O - K_2O - CaO$ System. W. Hänlein. *Zeits. f. techn. Physik*, 14. 10. *pp.* 418–424, 1933.—A brief description of the preparation of the glasses in the $SiO_2 - Na_2O - K_2O - CaO$ system is given together with an outline of the methods of measuring their conductivity, expansion coefficient, specific gravity and viscosity. Curves are given showing the relation between these properties and the constitution of the glasses and it is concluded that, generally speaking, the laws obtaining for a two-dimensional glass system also hold good for a system of several dimensions. W. D. W.

5368. Superficial Dilatation of Elastic Solids. D. Palermo. *Accad. Lincei, Atti.* 18. *pp.* 140–145, *Aug.*, 1933.—A mathematical study of some particular cases of the dilatation of elastic solids. J. J. S.

See also Abstract 5377.

EVAPORATION.

5369. Evaporation and Diffusion of Volatile Materials into an Inert Gas Stream. E. Preston. *Faraday Soc., Trans.* 29. *pp.* 1188–1198, *Nov.*, 1933.—Published results of other observers are used to explain the mechanism of evaporation. It is concluded that the evaporation from a surface at normal pressures is in essence a process by which a thin vapour or " super surface " layer, in equilibrium with the liquid phase, diffuses into the passing gas. The diffusion appeared to be governed by the same considerations as those deduced from the kinetic theory for the diffusion of gases in an enclosed space. F. J. B.

MELTING AND BOILING POINTS.

See Abstract 5369.

TEMPERATURE, MEASUREMENT OF.

See Abstracts 5162, 5374.

THERMOCHEMISTRY.

5370. Heats of Dissociation of Hydrogen and Nitrogen. W. W. Lozier. *Phys. Rev.* 44. *pp.* 575–581, *Oct.* 1, 1933.—A method previously described has been employed to determine the heats of dissociation of the normal molecule and the molecular ion for H_2 and N_2. A new apparatus has been constructed of tantalum, which eliminates previous difficulties, believed due to contact potentials. As previously shown, electrons passing through diatomic gases are able to produce atomic ions possessing kinetic energies of several volts. Simultaneous measurements of the electron energy necessary to produce atomic ions and the kinetic energy of the ions permit the determination of the heats of dissociation. The values obtained are $D(H_2^+) = 2\cdot59 \pm 0\cdot03$ V, $D(H_2) = 4\cdot43 \pm 0\cdot03$ V, $D(N_2^+) = 6\cdot73 \pm 0\cdot02$ V, $D(N_2) = 7\cdot90 \pm 0\cdot02$ V. It is concluded that these results are free from systematic errors to $\pm 0\cdot1$ V. A critical comparison of these data is made with the results of other methods, mainly spectroscopic. AUTHOR.

5371. Effect of Change of Composition on the Ignition Region of Methane-Oxygen Mixtures. M. B. Neumann and A. I. Serbinov. *Phys. Zeits. d. Sowjetunion*, 4.3. *pp.* 433–442, 1933. *In English.*—It has been shown that the admixture of argon to methane-oxygen mixtures does not change the time lag but extends the region of ignition. The alteration of the lower limit obeys Semenoff's law. The region of ignition gradually changes with the methane concentration and three limits of ignition exist in mixtures containing from 3 % to 37 % of methane. AUTHORS.

V. 19

THERMODYNAMICS.

5372. Formula for Specific Volumes of Saturated Vapours. C. H. Meyers. *Bureau of Standards, J. of Research,* 11. *pp.* 691–701, *Nov.,* 1933.—A formula for calculating the specific volume of saturated vapours is given. This formula expresses the specific volume of the vapour in terms of the vapour pressure, the specific volume of the liquid, and two empirical constants, one of which was the same for all the substances tried. The liquid volume need be known only approximately. For pressures up to one fourth the critical pressure, the formula represents the data on 23 substances within the experimental error. Graphs are given showing the application of the formula to 15 substances. An equation of state applicable over a limited range, to superheated vapours, is developed from an approximation to this formula and an assumption in regard to the form of the isotherms. [See also Abstract 2503 (1933).] AUTHOR.

5373. Equation of State and Parachor Relation. A. Eucken. *Göttingen Nachrichten, Math.-Phys. Klasse, No.* 3. *pp.* 340–349, 1933.—It is shown that the parachor relation $V^n\sigma$ = const. (n = 4 or $3\frac{1}{3}$) may be derived from a simple general equation of state for fluids, which can be employed for high pressures and is in agreement with London's equation. The additivity of parachor is accounted for by its being about 2·9 times the volume at T = 0°. T. L. M.

5374. Correlation of Heat Capacity, Absolute Temperature and Entropy. G. A. Linhart. *J. Chem. Phys.* 1. *pp.* 795–797, *Nov.,* 1933.—Starting with the two assumptions that at very low temperature the heat capacity is proportional to the entropy, and that at relatively high temperature it approaches a limiting value (C_∞), very simple relations are obtained between the heat capacity and the absolute temperature, and between the entropy and the absolute temperature of a given substance, by the introduction of a simple algebraic function which satisfies the two assumptions. The validity of these relations is substantiated by the excellent agreement of the observed and the calculated values for the heat capacities and for the entropies of a considerable number of substances, ten of which are given in this paper. AUTHOR.

5375. Ratio $\lambda m/\sigma m$ for Crystals and Liquids. R. Kaischew and L. Krastanow. *Zeits. f. phys. Chem.* 23. *Abt.B.* 1–2. *pp.* 158–162, *Oct.,* 1933.—Based on the work of separation of ideal homopolar crystals, conclusions are drawn with respect to the quotient $\lambda m/\sigma m$, where λm is the molecular heat of evaporation and σm is the molecular surface energy. It is shown that this quotient must always be greater than 2 for liquids. The definition of "sharp boundary" as between liquid and surrounding medium (gas phase) is rendered precise. H. H. Ho.

5376. Theory of Distribution of Electrolytes Between a Solid Crystalline and a Liquid Phase. A. P. Ratner. *J. Chem. Phys.* 1. *pp.* 789–794, *Nov.,* 1933.—A short discussion of the nature of distribution equilibria between mixed crystals and aqueous solutions is given. From the general theory of the thermodynamical potential and the activity theory of strong electrolytes, equations are deduced giving the influence of the composition of the liquid phase on the distribution ratio and the dependence of the partition constant on the properties of the pure components. The relative importance of the various factors in these equations, depending on the concentrations and properties of the components, is discussed. The deduced equations are in agreement with the experimental data. AUTHOR.

5377. Jump in the Expansion Coefficient of Liquid Helium in Passing the λ Point. W. H. Keesom. *K. Akad. Amsterdam, Proc.* 36. 2. *pp.* 147–152, 1933. *Comm. No. 75a from the K. Onnes Lab., Leiden.*—It was found in the course of some previous work [see Abstract 277 (1933)] that the diffusion of heat in a calorimeter of liquid helium was much quicker below 2·19° K than above. In that work heat was supplied to the liquid helium from above, and as the density of helium reaches a maximum about 2·19° K it was suggested that the cause of the quicker heat diffusion below 2·19° K was convection. This explanation seemed, however, to be contrary to thermodynamics. In the present communication it is shown that this is not so and that the convection explanation may be accepted. A thermodynamical agreement is used to derive a relation between the slope of the λ curve, the λ temperature and the discontinuities of the expansion coefficient and specific heat at the λ point. [See following Abstract.] L. G. C.

5378. Phase Changes in the Usual and Wider Senses Classified according to the Corresponding Singularities of the Thermodynamic Potential. P. Ehrenfest. *K. Akad. Amsterdam, Proc.* 36. 2. *pp.* 153–157, 1933. *Suppt. No. 75b from the K. Onnes Inst., Leiden. In German.*—A mathematical discussion, with special reference to the case of liquid helium [see preceding Abstract]. L. G. C.

5379. Para- and Ortho-Hydrogen. L. Farkas. *Ergeb. d. exakt. Naturwiss.* 12. *pp.* 163–218, 1933. After a short historical introduction the author gives the quantum-mechanical theory of the para- and ortho-states in the case of H_2 and deduces certain consequences. A chapter is devoted to enumerating the experimental results concerning the properties of para- and ortho-hydrogen (pH_2 and oH_2); the sub-sections are: preparation of pure pH_2, specific heat, heat of transformation, entropy, free energy, chemical constant and vapour pressure, optical properties, magnetic properties of pH_2 and oH_2, chemical properties, gas-kinetic data. The transformation of the one form of H_2 into the other, and vice versa, is discussed; the processes used are: (*a*) radiation, (*b*) thermal transformation and the reaction $H + pH_2 \rightleftarrows oH_2 + H$, (*c*) transformation by means of paramagnetic materials, (*d*) transformation of liquid and solid hydrogen. Bonhoeffer and Harteck's heterogeneous catalysis of the concentration of the two types of hydrogen is described. The applications of the results obtained to various problems, such as the measurement of the concentration of H-atoms in reacting gas mixtures (by using the above reversible action), or the energy-exchange at the boundary, metal-H_2, and the termination of the self-diffusion constant of H_2, are given in detail. This comprehensive survey of our knowledge of p- and o-H_2 closes with 97 references to original papers. H. L. B.

See also Abstracts 5107, 5185, 5370.

VAPOUR PRESSURE.

See Abstracts 5120, 5372.

ACOUSTICS.

5380. Investigation of Supersonic Waves by Means of the Resistance Thermometer. N. N. Malov. *Hochfrequenztechn. u. Elektroakustik,* **42.** *pp.* **115–119,** *Oct.,* **1933.**—A resistance thermometer was used for investigating the energy distribution of supersonic waves in transformer oil. The waves were produced by excitation of a quartz plate, the frequency employed being 573 kc./s. Graphs are given illustrating the effects of reflection, scattering and refraction, and also the formation of stationary waves in the liquid. The velocity of propagation of such waves in transformer oil, water and 7 % salt solution was found to be 1865, 1430 and 1520 m./sec. respectively, the two latter values being in good agreement with the results of Hubbard and Loomis. A. W.

5381. Optical Demonstration of the Wall Thickness of Maximum Transparency for Ultrasonic Waves. E. Hiedemann and H. R. Asbach. *Phys. Zeits.* **34.** *pp.* **734–735,** *Oct.* **1, 1933.**—A practical note. H. F. G.

5382. Velocity of Supersonic Waves in Liquids. L. Bergmann. *Phys. Zeits.* **34.** *pp.* **761–764,** *Oct.* **15, 1933.**—When stationary supersonic waves are generated in a liquid, an incident beam of light is transmitted through the liquid as through a diffraction grating, and from the optical measurements, the wave-length and thus the velocity of the supersonic waves may be deduced. By employing the harmonics of a quartz crystal generator, a greatly increased optical dispersion is secured, and in consequence a more accurate velocity determination. In one case, experiments are performed with harmonics up to the 69th. The supersonic velocity is found for a number of frequencies and in the following liquids: xylol, water, salt solutions of various strengths, and chloroform. For frequencies between 10^6 and 25×10^6 c.p.s., the velocity in xylol is constant. J. P. A.

5383. Supersonic Interferometer for the Study of the Pressure Coefficient of Velocity. J. C. Swanson. *Rev. Sci. Instruments,* **4.** *pp.* **603–605,** *Nov.,* 1933.—The fundamental principles of the interferometer, particularly the liquid supersonic interferometer of Hubbard and Loomis, are incorporated in an instrument in which the liquid under examination may be put under pressures up to about 10,000 lb./sq. in. The instrument and the pressure device are built into a block of special cast steel $8 \times 5 \times 4\frac{1}{2}$ inches. The results given are preliminary and merely show the performance and precision of the instrument. A curve is given showing the change of velocity of a h.f. acoustic wave of 195 kc. from 1143 m./sec. at atmospheric pressure to 1233 m./sec. at a pressure of 3105 lb./sq. in. in CS_2 at room-temperature. (The room-temperature varied at different readings from 22·25° C. to 25·41° C.) AUTHOR.

5384. Analysis and Interpretation of Vowel Tracks. E. W. Scripture. *Acoustical Soc. of America, J.* **5.** *pp.* **148–152,** *Oct.,* **1933.**—In a sound track registered on a film, the speech " stretch " consists of a series of contiguous speech " bits," each of which begins with a strong upward movement. In a vowel record the bits have very pronounced forms of similar character, although no two profiles are exactly alike, and there is a progressive change. There is also a steady change in the length of these vowel bits. Repeated movements within a bit are termed pulsations, and $2\pi \times$ frequency of the pulsations gives the pulsatance. The slowest inner pulsatance is independent of the duration of the bit, also the time from one centroid, or centre of gravity of a pulsation, to the next is not constant within the bit. Further, the pulsations within a bit start strong and become rapidly weaker. In a study of the vowel sound *ay*, as in *may*, the sound lasted ·41 sec., contained 49 bits, and frequencies round 154, 898 → 1025 → 535, 2500 and 6280. The profile of the sound track in each vowel bit is the registration of the vibratory movement that occurred in the air in the vocal cavity. The initial maximum and subsequent decrement show that a vowel bit is a free vibration of a system subjected to a brief impulse and then left to itself. The form of the profile of the record is determined by the properties of the vocal cavity. The sound track of a vowel contains not only information concerning the sound in its language relations, but also a most complete characterisation of the speaker himself. Sound tracks may be used to develop a science of personality, and have been used successfully for the diagnosis of nervous diseases. [See also Abstract 4995 (1933).] G. E. A.

5385. Rôle of the Tympanic Membrane and Ossicles in the Hearing of Subjective Tones. D. Lewis and S. N. Reger. *Acoustical Soc. of America, J.* 5. *pp.* 153–158, *Oct.*, 1933.—The hearing of subjective tones, such as difference tones, has generally been ascribed to the asymmetrical action of the tympanic membrane. If such tones are caused by vibrations in either the tympanic membrane or the ossicles, persons who have no tympanum and no ossicles should be unable to hear these tones. Three subjects who had lost membrane and ossicles were tested, and all of them heard the subjective tones when the stimulus tones were presented to them. The authors conclude that the tympanic membrane and ossicles are not necessary for the hearing of subjective tones. G. E. A.

5386. Loudness, Its Definition, Measurement and Calculation. H. Fletcher and W. A. Munson. *Acoustical Soc. of America, J.* 5. *pp.* 82–108, *Oct.*, 1933.—On account of refinements in experimental technique the previous work on the subject [see Abstracts 175 (1925) and 566 (1926)] has been reviewed. The present paper reports additional experimental work, and an expression for calculating the loudness level of a steady complex tone is formulated. The terms defined in the following Abstract are employed and the discussion is confined to sounds which are steady. The experimental work was performed by a group of eleven observers whose results were carefully controlled and analysed. The stages in the formation of the empirical theory upon which the final expression is based are: (i) the magnitude of the auditory sensation, N, for a single tone is a function of its frequency, f, and its intensity level, β, *i.e.*, $N = G(f, \beta)$; (ii) this single tone in combination with other simple tones in a complex sound contributes, on account of interference, bN to the resulting sensation, where $1 > b > 0$. The auditory sensation of a complex tone is thus given by $\sum_{n=1}^{n=k} b_k G(f_k, \beta_k) = \sum_{n=1}^{n=k} b_k G(1000, L_k)$ where L_k is the intensity level of the reference tone of frequency 1000 c.p.s. equal in sensation to the tone designated by f_k, β_k. The experimental work undertaken was therefore a determination of: (*a*) the relation between L_k, f_k, and β_k. This was done by alternatively feeding into headphones a note of known frequency and level and a 1000 c.p.s. note of variable level and calling upon the observer to determine the louder tone. The experimental arrangements are reported in Appendix A of the paper and in Appendix B a comparison is made with the previous results of Kingsbury [see Abstract 2342 (1927)]; (*b*) the loudness function G. A consideration of the theory of hearing shows that for a complex tone whose components are widely separated in frequency $b_k = 1$. If, in addition, the values of L_k are equal, the expression for the auditory sensation becomes nG (1000, L_k), and a method of determining G is indicated. An optical tone generator was employed to obtain the required complex sound; (*c*) a formula for b_k on the assumption that the neighbouring component on the side of lower pitch accounts for all the reduction from unity. For the many details involved reference should be made to the original paper which concludes with a comparison of observed and calculated results on the loudness levels of complex tones. E. J. I.

5387. Proposed Standards for Noise Measurements. *Acoustical Soc. of America, J.* 5. *pp.* 109–111, *Oct.*, 1933.—These recommendations of the American Standards Association Committee on Acoustical Measurements and Terminology are concerned with the definition and realisation of quantities dealt with in noise measurements. They are, in short, (i) the reference intensity for intensity level comparisons to be 10^{-16} watt per sq. cm.; (ii) intensity level of sound to be the number of db above reference level; and (iii) loudness level of any sound to be intensity level of equally loud 1000 c.p.s. tone. Additional tentative standards defined by curves are suggested and a discussion is appended. See also **H. Fletcher.** *Elect. Engineering,* 52. *pp.* 744–746, *Nov.*, 1933. E. J. I.

5388. Acoustical Theory of Exhaust Silencers of the Perforated Baffle Type. A. H. Davis. *Phil. Mag.* 16. *pp.* 787–793, *Oct.*, 1933.—The author discusses the working of baffle plate exhaust silencers, two types being considered, (*a*) those in which the successive chambers are connected by apertures and (*b*) those in which they are connected by tubes. The theory is simplified by considering the silencer to be made of an infinite number of chambers, the dimensions of which are small compared with the wave-length of the sound. It is shown that both types may be regarded as low-pass acoustical filters, and calculations based on certain silencers indicate that the cut off frequency is 100 $\sim$ approx. J. E. R. C.

5389. Resistance to Air-Flow in Sound Absorbers. A. Gemant. *Preuss. Akad. Wiss. Berlin, Ber.* 17. *pp.* 579–588, 1933.—The acoustic absorption coefficient of a material depends on its porosity and on its resistance to the motion of air in the pores, and these two factors are not independent. Two methods are adopted for estimating the resistance in various absorbing materials. In the first, the resistance of a slab of the material is compared with that of a measured glass capillary. In the second the velocity of a stream of air drawn through the material by a small pressure head is measured by charging the air with a small quantity of CO_2. The presence of the CO_2 is revealed by a chemical indicator in front of and behind the specimen. The times of entrance and emergence of the stream are therefore signalled. Observations are made on five absorbing materials, and where possible, results are compared with the direct measurements of absorption coefficients. J. P. A.

5390. Absorption of Sound in Air, Oxygen and Nitrogen. Effects of Humidity and Temperature. V. O. Knudsen. *Acoustical Soc. of America, J.* 5. *pp.* 112–121, *Oct.,* 1933.—A continuation of the author's work [see Abstract 162 (1932)]. The rates of decay of sound in two gas-filled chambers of unequal volume are determined by an electro-acoustical apparatus similar to that described by Norris and Andree, and from the results the absorption of sound is calculated. Alternatively, by means of a preliminary calibration, the required absorption coefficient is determined by measurements in only one chamber. The effects of temperature, frequency of note, and size of chamber on the absorption of sound in air-water vapour mixtures are shown by a series of curves. These indicate (i) a maximum of absorption when the percentage of water molecules is between 0·2 and 0·4, and (ii) the maximum absorption coefficients are approximately proportional to the first power of the frequency. On account of their theoretical importance absorption curves were also determined for O_2-water vapour and N_2-water vapour mixtures. For O_2 the maximum values of the absorption coefficients are some five times greater than the corresponding ones for air and occur when the percentage of water molecules is greater. With N_2 the absorption coefficient is almost independent of the presence of water molecules. The paper concludes with some remarks on the bearing of these experiments on architectural acoustics and sound signalling. [See also Abstracts 2504 and 5115 (1932) and following Abstract.] E. J. I.

5391. Interpretation of the Anomalous Sound-Absorption in Air and Oxygen in Terms of Molecular Collisions. H. O. Kneser. *Acoustical Soc. of America, J.* 5. *pp.* 122–126, *Oct.,* 1933.—The author shows mathematically that the experimental results of Knudsen on sound absorption in moist gases [see preceding Abstract] may be interpreted very satisfactorily in terms of the rate of adjustment of the internal equilibrium between vibrating and non-vibrating (normal) molecules. With the added assumption that what may be termed the " velocity constant " for vibrating molecules depends upon the square of the ratio of the number of water molecules to the number of other molecules, additional quantitative agreement of a high order is shown to exist between the theory propounded and observations on the effect of the percentage of water on the absorption in air and in oxygen. [See also Abstract 1971 (1933).] E. J. I.

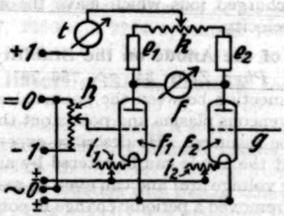
5392. Transportable Apparatus for Measurement of Reverberation Time and Sound Intensity. J. Holtsmark and V. Tandberg. *E.N.T.* 10. *pp.* 389–392, *Oct.,* 1933.—A description is given, with circuit diagram, of apparatus for automatically measuring the reverberation time of rooms. The principle of the apparatus, which is transportable, is as follows: The sound given out by a loudspeaker is received on a condenser microphone and the resulting voltage amplified, rectified and applied to a relay, which opens as long as the rectified current exceeds a certain value. An electrical time measuring device, depending on the charging of a condenser through a resistance, is utilised for measuring the time when the relay closes again. The whole process is then repeated as often as desired. A simple modification of the apparatus allows it also to be used for the measurement of sound intensities. A. W.

See also Abstract 5360.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

5393. New Wheatstone Bridge Circuit. E. Haschê. *Phys. Zeits.* 34. *pp.* 718–720, *Sept.* 15, 1933.—Suggests improving the accuracy of the valve bridge (see Figure) developed largely by Wynn Williams, Brentano and others by including in the circuit a sensitive galvanometer *t*, so compensated that the steady anode current does not pass through it. If the bridge galvanometer *f* varies while *t* remains steady, the resistances f_1, and f_2 must so vary that the total bridge resistance remains constant. By combining the galvanometers *f* and *t* in one differential galvanometer, some of the bridge errors may be reduced, and the sensitivity of the arrangement may be doubled. G. E. B.



See also Abstract 5487.

CONDUCTION AND DISCHARGE IN GASES.

5394. Models Illustrating the Theory of Electric Breakdown and Discharge in Gases. W. Rogowski and W. Fucks. *Arch. f. Elektrot.* 27. *pp.* 743–748, *Oct.* 4, 1933.—Diagrams are given of three-dimensional models exhibiting the growth of ionisation for a range of potentials and electrode distances. These models are used to explain briefly the latest assumptions concerning electric breakdown and discharge in gases. An explanation is also given of the phenomena of breakdown due to more than one initial electron. A. W.

5395. Theory of the Arc Discharge. R. Seeliger and K. Bock. *Phys. Zeits.* 34. *p.* 767, *Oct.* 15, 1933.—The older, purely thermal theory of the arc discharge is at variance with experiments on the Cu arc open to the atmosphere [see also Abstract 5003 (1933)]. In this instance, the sudden change from the glow into the arc discharge is dependent on the current density at the kathode but is not controlled by the temperature of the surface of the kathode. F. C. C.

5396. Glow Discharge at Atmospheric Pressure. H. Thoma and L. Heer. *Zeits. f. techn. Physik,* 14. 10. *pp.* 385–388, 1933.—Continuing previous work [see Abstract 324 (1933)] on the glow discharge at atmospheric pressure, the similarity of the behaviour of the discharge under various physical conditions at all pressures is repeatedly shown. Investigations on the positive column show that the properties of the glow discharge at low pressures, where no thermal ionisation is exhibited, are continued at higher pressures, the phenomena being quite distinct from those of the arc discharge. F. C. C.

5397. Vapour Stream in Vacuum Arcs. R. C. Mason. *Elect. Engineering*, 52. *pp.* 702–705, *Oct.*, 1933.—A summary of the experiments showing the existence of a high-velocity vapour stream issuing from the kathode region of a vacuum arc is presented in this article. Velocities obtained by different methods are given. A review of the theories proposed to account for the vapour is included, several of which are shown to be inadequate. The one possible theory is based upon the presence of multiple-charged ions which leave the kathode after neutralisation with a high velocity. AUTHOR.

5398. Influence of the Anode on the Stability of Discharges in Argon. W. Pupp. *Phys. Zeits.* 34. *pp.* 756–761, *Oct.* 15, 1933.—The author shows the connection between the potential of the anode and the stability of the homogeneous plasma and points out that a certain stability of the plasma must be assumed. He describes experiments to show that the fall of potential at the anode can be altered by artificial generation of ions (by means of low voltage arc) and can even be made negative. When the artificial source is removed a periodic change in potential and brightness in the region near the anode is observed. The experimental results are illustrated by curves. R. L.

5399. Studies of Rare-Gas Sodium Arcs with the Use of Collectors. T. Harada. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 371–383, *Oct.*, 1933. *In English.*—In the He, He + Na, Ne, Ne + Na, A, A + Na arcs with hot kathodes, the space potential, electron current density and electron temperature were determined by the probe method near the kathode and anode and in the positive column. The variations of kathode fall, potential gradient in the positive column, anode fall and of electron temperature with the kind of rare gases and with vapour pressure of sodium are studied from the above measurements. AUTHOR.

5400. Theory of the Stoppage of Fast Electrons. S. Flügge. *Zeits. f. Physik*, 85. 11–12. *pp.* 693–696, *Oct.* 14, 1933.—The rate of decrease of energy of fast electrons in matter is calculated with the aid of a formula derived by Heisenberg. Curves are drawn showing the calculated values of the energy at various depths in water and lead for both high and low values of the initial energy (E/mc^2 from 20 to 1020). The results obtained are compared with those of Heisenberg and the discrepancies briefly discussed. H. J. H. S.

5401. Influence of Space-Charge Effects in Measurement of Excitation Functions. J. M. W. Milatz. *Zeits. f. Physik*, 85. 9–10. *pp.* 672–675, *Sept.* 30, 1933.—In some tests preliminary to the making of a tube with which to measure the excitation function of the metastable level of Ne, it emerged that the velocity of the electron group, measured in volts, was not always equal to the p.d. between the glowing kathode and the receiving cage. A method is described for measuring the above-mentioned velocity, and is applied to the determination of space charges. G. E. A.

5402. Arrangement for Determining the Resonance Levels of Mercury. G. Mönch. *Phys. Zeits.* 34. *pp.* 765–766, *Oct.* 15, 1933.—The construction and use of a small and generally useful apparatus for determining the resonance levels of Hg is given with drawings of the tube and of the electrical circuit. A curve is given showing results obtained. J. E.

5403. Positive Ion Excitation of Mercury Vapour. E. J. Jones. *Phys. Rev.* 44. *pp.* 707–710, *Nov.* 1, 1933.—Mercury vapour was bombarded by Li^+ and K^+ ions and the resulting spectra photographed with a quartz spectrograph and the plates photometered to give an approximate intensity-velocity curve. Voltages used ranged from 150 to 1500 volts. The results indicate that the velocity rather than the energy is the important factor to be considered in the mechanism of the collision process. A preference seems to exist for the excitation of levels of higher L values. The spark lines 2847, 2260 and 2224 appear at 1000 volts for Li^+ ions. A powerful source of positive ions has been developed. AUTHOR.

5404. Collision Effects of Slow Positive Ions in Inert Gases. M. Nordmeyer. *Ann. d. Physik,* 16. 6. *pp.* 697–719, *March,* 1933.—Part I deals with the problem of finding a source of ions which is constant and copious, in order that clearly defined results may be obtained. Experiments were made with mixtures made up from KCl and Al_2O_3 and from CsBr and Al_2O_3, fused together with Fe_3O_4. The ionisation function of K^+-ions as far as 1000 volts velocity was measured in argon. The results are compared with those of O. Beeck, and the quantitative disagreements are discussed. By extrapolating the ionisation function the author obtains 75 volts as the value at which ionisation first appears. H. L. B.

5405. Doppler Effect in Spectra of Positive Rays of Uniform Velocity in Argon, Neon and Helium. Anna I. McPherson. *Phys. Rev.* 44. *pp.* 711–716, *Nov.* 1, 1933.—Ions of argon, neon, helium, formed in a low voltage arc have been accelerated to high speeds in a short electric field, forming beams of positive ions which all have the same energy. The spectra of the beams of positive rays of uniform energy observed in the direction of motion show a characteristic Doppler effect, with displaced lines fully as sharp as the rest lines. With the exception of the very intense λ3418 of neon, the arc lines of argon and neon have no Doppler effect, while the lines of the first spark spectrum are accompanied by sharp displaced lines only slightly less intense than the rest lines, whose separation corresponds accurately to the speeds acquired by singly charged ions in the accelerating field, for velocities 9000 to 28,000 volts and several lines of higher spark spectra were observed with displaced lines also corresponding to singly charged ions. Satisfactory observations are made at pressure about 5×10^{-3} mm., the intensity and sharpness of the displaced lines diminishing with increasing pressure. In helium, the arc lines show relatively faint displaced lines corresponding to singly charged ions; one spark line λ4686 was accompanied by a relatively intense displaced line, while the only other spark line observed, λ4541, had no Doppler effect. AUTHOR.

5406. Effect of Internal Discharges on the Successive Functioning of the Geiger-Müller Tube Counter. R. Brunetti and Z. Ollano. *N. Cimento,* 10. *pp.* 189–197, *May,* 1933.—The wall of a Geiger-Müller counter was raised to + 1800 V so that it was discharging spontaneously and was left in this condition for a short time. The counter was then used normally, *i.e.*, the potential was reversed in sign and reduced to about −1300 V. An abnormally high number of spontaneous discharges was now recorded but as time went on the counter regained normality. This activation effect was not shown if the wall was initially raised to a negative potential of −1800; also it did not occur with brass but was markedly present with a wall of Al, Mg, Zn, Cu or Pb. Substitution of hydrogen for air in the counter produced no effect on the phenomenon. The counter was enclosed in a steel case throughout the experiments. The general behaviour was very similar to that of a counter which has been exposed to X-rays. F. C. C.

5407. Proportional Amplifier for the Detection of Single Ionising Corpuscles. B. Zipprich. *Zeits. f. Physik,* 85. 9–10. *pp.* 592–617, *Sept.* 30, 1933.—The ionisation produced by a single α-particle in air was measured by the amplification obtained by ionisation by collision below the sparking limit. The validity of the method depends upon the production of a homogeneous field between plane electrodes and the existence of a well-defined region of primary ionisation: a Hoffmann vacuum electrometer was used as recording instrument. By means of a grid device, disturbing effects due to the scattering of the α-particles, were eliminated. Up to 60 mm. pressure the amplification was by a factor of 10^4; a fast β-particle in 2 cm. of path gave a throw of 3 mm. with an electrometer sensitivity of 25,000 E-Qu./mm. The dependence of the amplification on the distance between the electrodes, the gas pressure and the field strength was examined and the optimum working conditions were determined. The experimental results were in agreement with Townsend's theory of ionisation by collision. Finally, the proportional amplifier was compared with the point and tube counters and it was shown that the method worked quantitatively with β-particles. F. C. C.

5408. Wide Angle Magnetic Spectrometer. C. D. Bock. *Rev. Sci. Instruments,* 4. *pp.* 575–580, *Nov.,* 1933.—It is pointed out that in certain problems advantages in current intensity would be gained by having a magnetic spectrometer which would focus widely divergent ions. The usual semicircular type of spectrometer brings divergent rays to a first order focus. By making the proper variation in the intensity of the deflecting magnetic field one can obtain a second order focus. An integral equation is developed to determine the required variation of the magnetic field and a simple method of obtaining the field is given. An instrument now in use for the study of aged ions in gases is briefly described.

AUTHOR.

See also Abstracts 5260, 5276, 5329, 5346, 5464.

CONDUCTION IN SOLIDS AND LIQUIDS.

5409. Conservation Theorem of the Metallic State. F. Bloch. *J. de Physique et le Radium,* 4. *pp.* 486–491, *Aug.,* 1933.—The periodic structure associated with the metallic state necessitates the invariance of the total energy of the system composed of conduction electrons and elastic vibrations. An integral of motion, which is more general than that previously obtained by Peierls [see Abstract 2076 (1932)] can be deduced from this. The fact that the deduction is independent of the variables used enables an answer to be made to a criticism made by Wilson [see Abstract 1328 (1932)] of Peierls' calculation. J. E. R. C.

5410. Preparation and Properties of Thin Lead Sulphide Layers and Investigation of their Detector Action. Part I. G. Brückmann. *Kolloid Zeits.* 65. *pp.* 1–11, *Oct.,* 1933.—This chemical investigation is concerned with the mechanism of lead sulphide mirror formation, the following results having been obtained : the reaction whereby the lead sulphide molecule is produced consists in the catalytic decomposition of a lead acetate-thiourea-complex salt. The processes in solution and at the boundary surface are influenced by temperature in the same sense. Certain substances retard whilst dust and fine precipitates accelerate the reaction. The amount of separating lead sulphide is proportional to the extent of surface, whose material is without effect except in the curves of copper and its alloys which become coated with cuprous sulphide. The separated lead sulphide is appreciably greater in amount on nuclear covered surfaces than on those freshly prepared. The theories of silver mirror formation are discussed, and the general requirements at particular surfaces derived. H. H. Ho.

5411. Rectifier Effect in Solid Insulators. P. Böning. *Zeits. f. Physik*, 86. 1–2. *pp.* 49–53, *Oct.* 17, 1933.—An ohmic resistance is connected in parallel with a condenser with solid dielectric, and the middle of the resistance is connected by a conducting bridge to the middle of the dielectric. When an alternating voltage is applied to the system, a direct current flows through the bridge. The effect is explained in terms of ionic adsorption at inner interfaces and the resulting non-uniform potential distribution in the insulator. Different possibilities with different materials are discussed. An account is given of experiments with solid soap, the results of which are in harmony with the theoretical considerations. L. A. W.

5412. Supraconductivity. F. Zwicky. *Nat. Acad. Sci., Proc.* 19. *pp.* 818–823, *Sept.*, 1933.—Suggests a new theoretical basis for the explanation of supraconductivity from considerations of certain cooperative phenomena and related secondary structures, and shows that it is analogous to the problem of the existence of a crystalline state of matter in that both phenomena exhibit (*a*) structure sensitive properties, (*b*) characteristic lengths of the order of $D = 10^{-4}$ cm. and (*c*) one or more extremely sharp transition points. The characteristics (*a*) (*b*) and (*c*) find a rational explanation and the difficulties related to the effect of grain boundaries in polycrystalline aggregates become less grave. Also explains theoretically why the transition temperature of supraconductivity is of the order of 1° K., and various other phenomena and discusses some characteristic lengths in crystals by combining some physical constants. [See also Abstract 1700 (1933).] R. L.

5413. Current Distribution in a Supraconducting Sphere. R. Becker, G. Heller and F. Sauter. *Zeits. f. Physik*, 85. 11–12. *pp.* 772–787, *Oct.* 14, 1933.—A calculation is made by various methods of the current which exists in a supraconducting sphere if this is set in rotation. From consideration of the mass inertia of the electrons there is found a current skin at the surface whose thickness amounts to about 10^{-6} cm. It is thereupon shown that the surface current also which is calculated in the supraconductor at rest by the usual application of Maxwell's theory can by stricter methods of consideration be replaced by a volume current of equal extent. J. J. S.

5414. Conduction of Antimony Sulphide. G. S. Frey. *Arkiv f. Kem. Min. och Geologie, Stockholm*, 11 A. 4. [22 *pp.*], 1933.—Crystallised antimony sulphide was obtained in homogeneous rod form by heat treatment of the chemically prepared salt. The rods for study were enclosed in opaque casings to eliminate the well-known effect of light on their electrical conductivity. The first measurements were made by passing current for a brief period with different applied voltages. Marked increase of conductivity with applied voltage was observed. Other measurements in which a constant voltage was maintained for over 100 hours showed an initial rise and then a drop to a final asymptotic value. The effects observed pointed to an electrolytic mechanism and two special investigations were made to detect actual transport of matter in the conduction process. The production of metallic Sb, although not established by analysis, was deduced from microscopic examination of the ends of the experimental rods, and an electrical exploration with a pointed electrode indicated that fine metallic filaments of Sb had been produced in the sulphide rods. W. S. S.

5415. Electrical Conductivity of Single Crystals. W. Lehfeldt. *Zeits. f. Physik*, 85. 11–12. *pp*. 717–726, *Oct*. 14, 1933.—The paper describes a preliminary investigation of the ionic conductivity of single crystals of the alkali halides with a special view to experiments in photoelectricity. The specific conductivities were determined for single crystals of 10 – 100 mm.^{3} with platinum foil electrodes between temperatures of – 180° C. and the melting point, and a table of the results is given. The current-potential curves were found to obey Ohm's law fairly well. In a narrow region immediately below the melting point the conductivity both for single crystals and pressed pastilles was found to be constant. Measurements on single crystals at very low temperatures showed the existence of a "*Störleitung*" depending on previous treatment, impurities and secondary conditions. The results are compared with those calculated by the van't Hoff equation and found to agree satisfactorily. R. L.

See also Abstracts 5451, 5452, 5477.

DIELECTRICS AND CAPACITANCE.

5416. H.F. Dielectric Constants of Aqueous Solutions. E. Plötze. *Ann. d. Physik*, 18. 3. *pp*. 288–298, *Oct*., 1933.—The dielectric constants of some aqueous solutions are investigated, using a development of Drude's method of comparing the wave-length of a Lecher wire system immersed in the solution with the wave-length in air. Solutions of $CuSO_4$, $La(NO_3)_3$ and $K_4Fe(CN)_6$ of concentrations up to 0·002 mol per litre are investigated at a frequency of $5 \times 10^8 \sim$. The variation of dielectric constant with frequency is studied and found to be smaller than the experimental error. This result is shown to be in agreement with the Debye-Onsager-Falkenhagen theory. J. E. R. C.

5417. Dielectric Constant and Absorption of Several Organic Fluids at 1·82 m. W. T. Szymanowski. *J. Chem. Phys.* 1. *pp*. 809–816, *Nov*., 1933.—For the further test of Debye's theory of anomalous dispersion, dielectric constants and absorptions were measured at $\lambda = 1{\cdot}82$ m. for the following fluids: ethyl alcohol, *n*-propyl alcohol, isopropyl alcohol, isobutyl alcohol, *n*-butyl alcohol, amyl alcohol, chlorobenzene, quinoline and nitrobenzene. The resonance method for undamped waves was used. The results are generally in good agreement with Debye's theory as well as with the results of Mizushima and others for fluids whose polarisations for infinite dilution do not differ greatly from those at normal concentration, as for the alcohols and chlorobenzol. For fluids like quinoline and nitrobenzene, the agreement is far from satisfactory. For these, however, when Malsch modification of Debye's theory is taken into account, a somewhat improved check is found, that for the dielectric constant being satisfactory, but that for the absorption of energy, while improved, being still far from satisfactory. AUTHOR.

5418. Dipole Moments of the Monomethyl- and Dimethyl-butadienes. E. H. Farmer and F. L. Warren. *Chem. Soc. J. pp.* 1290–1304, *Oct.*, 1933.—These investigations represent attempts to discover whether the considerable difference in additive properties which exists between the two monomethyl- and the five dimethyl- butadienes corresponds to a discernible permanent difference in the polar condition of the individual molecules. The data obtained would seem to indicate that alkyl substitution at the α-carbon atom of a butadiene chain causes a greater permanent polarisation of the molecule than similar substitution at the β-carbon atom. In addition, any small permanent moments which may characterise the two halves of the molecule in βγ-dimethyl-butadiene must be opposed directionally or otherwise neutralised, since this hydrocarbon has zero moment. The dipole moments are as follows : α-methyl-butadiene ($0\cdot50 \times 10^{18}$ e.s.u.), αα-dimethyl (0·52), βγ-dimethyl (0·0), β-methyl- (0·15), αβ-dimethyl (0·53), αγ-dimethyl (0·59), αδ-dimethyl (0·36 and 0·31, for two fractions of lower and higher boiling point respectively). H. H. Ho.

5419. Dipole Moment and Group Rotation. Part I. Moments of Chloro- and Nitrobenzyl Chlorides and the Effect of Group Separation. J. M. A. de Bruyne, R. M. Davis and P. M. Gross. *Am. Chem. Soc., J.* 55. *pp.* 3936–3944, *Oct.*, 1933.—The dipole moments of these chlorides have been determined in various solvents, using the Debye formula. The value for *p*-chlorobenzyl chloride differs considerably from that of Bergmann and Engel. A table of results is given showing the relation of the separation of the principal dipoles and the freedom of rotation. W. R. A.

5420. Electric Moments of Cyclic 1 : 1-Dicarboxylic Esters in Relation to the Valency Deflection Hypothesis. E. H. Farmer and N. J. H. Wallis. *Chem. Soc. J. pp.* 1304–1309, *Oct.*, 1933.—The observed change in the dipole moment from ring to ring is shown graphically, and is contrasted with the change in the moment which would be expected to obtain if the external valency angles in the different ring systems were actually those put forward by Beesley, Ingold and Thorpe. For the purpose of calculating the moments on the latter basis, Smyth's value for the moment of the carbethoxyl group is employed. The magnitude of the group moments for the 3-, 4-, and 5-membered rings is found to change in the reverse way to that predicted on the Thorpe-Ingold hypothesis, and only in passing from the 6- to the 5-membered ring is the direction of change the same. Moreover, the minimum moment occurs in the case of the 5-membered ring, the other rings being grouped in conformity with the Baeyer hypothesis. The results are discussed from the standpoint of validity, and the minimum value above is ascribed to two effects which are working in opposite directions. H. H. Ho.

5421. Power Loss Phenomena in Liquid Dielectrics. W. Jackson. *Roy. Soc., Proc.* 142. *pp.* 606–620, *Nov.* 1, 1933.—The paper describes a series of power loss measurements on samples of benzene, toluene, chlorobenzene and nitrobenzene over the frequency range $2 \times 10^5 - 2 \times 10^6 \sim$ before and after the application of d.c. voltage. A substitution method of condenser resistance measurement was adopted in which two continuously variable condensers of identical construction were compared. One was an air condenser and acted as standard while the other carried the liquid under test. A description of the special precautions taken is given and the method of purification of the liquids. The experiments were made to investigate the change of dielectric loss with frequency at constant temperature, the variation of loss resistance with temperature at constant frequency, and the behaviour of the dielectric under steady potential and following prolonged steady voltage. The leakage resistance was found to be independent of frequency. The loss resistance was found to increase continuously with temperature simultaneously with rapid decrease of dielectric constant. The effect of steady voltage application was to cause a decrease in the h.f. loss resistance to an increasing extent with increased time of application, with an approach to complete recovery after four hours under certain conditions. A small reverse current was found to exist during recovery which passed through a maximum value before decreasing slowly to zero. An explanation of the results is given. R. L.

5422. Calculation of the Capacity of a Condenser with Inclined Circular Plates. H. Nitka. *Zeits. f. Physik.* 85. 7–8. *pp.* 504–510, *Sept.* 23, 1933.—A formula is deduced for the capacity of a condenser with circular plates inclined to one another. Even at very small inclinations the values obtained from this formula differ considerably from those calculated from the usual simpler approximate formulæ. The correctness of the theoretical part is tested and confirmed by capacity measurements upon a condenser at different mutual inclinations of the plates. L. A. W.

See also Abstract 5394.

ELECTROCHEMISTRY.

5423. Glow Discharge Electrolysis. A. Klemenc and H. F. Hohn. *Zeits. f. phys. Chem.* 166. *Abt.A.* 5–6. *pp.* 343–356, *Oct.*, 1933.—The differences between glow discharge electrolysis [see Abstract 3657 (1931)] and ordinary electrolysis are discussed for certain cases. An account is given of experiments on the glow discharge electrolytic oxidation or reduction of solutions of sulphuric acid, potassium chlorate, perchloric acid and some metal salts. It is found that the products are qualitatively independent of whether the electrode in the gas space is made the anode or the kathode, but that the current yield is greater in the kathode potential fall than in the anode fall. The fact that the current yield is considerably greater than would correspond to the Faraday equivalent indicates that the electrochemical processes in glow discharge electrolysis involve electrically neutral active substances such as atomic hydrogen or oxygen. L. A. W.

5424. Dependence of the Volta Potential of the Systems Ag/Ag(soln.) and Cu/Cu(soln.) upon Concentration. M. Andauer and E. Lange. *Zeits. f. phys. Chem.* 166. *Abt.A.* 3–4. *pp.* 219–227, *Sept.*, 1933.—The potential of the system Ag/Ag(soln.) was measured over a range of concentrations from 0·1*N* to 10*N* by means of the ionisation method. By means of the results obtained for the change of voltage with the concentration, it was calculated that for each change of concentration of a power of ten of the silver ions, the voltage did not change by more than 0·01 volt. Preliminary measurements on similar lines were made on the system Cu/Cu (soln.). F. J. B.

5425. Dependence of Minimum Voltage of Electrolytic Valve Action on Defining Variables. O. Mohr. *Zeits. f. Physik*, 85. 11–12. *pp.* 679–692, *Oct.* 14, 1933.—The limiting voltage for the valve action of Al and Ta was obtained by comparison measurements with the oscillograph. The minimum voltage was only slightly influenced by current density. The minimum voltage increased as a linear function of the formation voltage. The effect of concentration of the electrolyte on the minimum voltage was slight. Frequency of the applied a.c. voltage was without influence on the minimum voltage. F. J. B.

5426. Mercury-Drop Electrode. E. Lange. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp.* 262–265, 1933.—The difficulties are discussed which are consequent on the assumption that at the mercury-drop electrode, there arises an electro-chemical and adsorption equilibrium. The opinion is expressed that a better explanation follows from the assumption of definite breaks in the passage of the ions which determine the potential differences. H. H. Ho.

5427. Electrodes of the Third Species. M. le Blanc and O. Harnapp. *Zeits. f. phys. Chem.* 166. *Abt.A.* 5–6. *pp.* 321–342, *Oct.*, 1933.—A formula is developed by means of which concentration changes taking place in electrodes of the third sort, as a result of reactions between the solid matter and the electrolyte, can be calculated. Electrodes of the third sort were prepared and measured. The electrodes were : $Hg/Hg_2WO_4 — CaWO_4 — C\breve{a}$, and $Hg/Hg_2C_2O_4 — CaC_2O_4 — C\breve{a}$. The latter electrode was proved to be useful. F. J. B.

5428. Mechanism of the Oxygen Electrode. T. P. Hoar. *Roy. Soc., Proc.* 142. *pp.* 628–646, *Nov.* 1, 1933.—With a view to determining the causes of the experimentally incomplete reversibility of the oxygen electrode, the kinetics of the processes were investigated. Results are consistent with a representation of the total electrode process by $O_2 + 2H_2O + 4\epsilon \rightleftarrows 4OH'$, which takes place, probably in stages, on the surface of the oxide film covering the inert electrode. The current flows between the film surface and the relatively anodic metal at the base of pores, pervious to the electrolyte, in the oxide film causing an irreversible removal of electromotively active material from the film surface, and a lowering of the potential. To maintain the reversible potential a small anodic current density, decreasing with time, is required. Kathodic and anodic polarisation curves were obtained for oxygen electrodes formed by platinum and gold in various oxygen-saturated electrolytes, and the log of the current density is linearly related to the electrode potential except at very low current density. Extrapolation gives 1·20 ± 0·03 volt at 25° for the reversible potential in good agreement with 1·227 volt calculated from thermal data. The extreme slowness of the reversible process leads to the view that it is impossible to prepare a truly reversible oxygen electrode, and is of importance in limiting the velocity of metallic corrosion. N. M. B.

5429. Phenomena in the Movement of an Electrode in an Electrolyte and Electrolytic Potential. M. O. Charmadarjan and B. I. Perwuschin. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp.* 334–339, 1933. —The movement of an electrode in an electrolyte was found to result in an electric current which flowed in different directions. The direction depended upon the composition or condition of the electrolyte, whether it was saturated or unsaturated with hydrogen. At small concentrations of hydrogen the moving electrode was negative, at high concentrations the moving negative electrode became positive. The change of direction of the current, which depended upon the quantity of dissolved hydrogen was considered to be analogous to the change in the charge of colloidal particles due to the addition of electrolytes. Hydrogen was shown to possess a definite polarity in acid solutions. F. J. B.

5430. Overvoltage. M. Volmer. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp*. 346–359, 1933.—The principal theories of overvoltage are discussed. It is suggested that the phenomenon is due to retardation of the discharge of the ions by capacity effects, and that the transfer of an electron from the metal to the ion in the double layer is a process requiring a certain energy of activation, which is dependent on the potential. The difference of behaviour of, *e.g.*, metal ions and hydrogen and hydroxyl ions is regarded as being probably purely quantitative. H. F. G.

5431. Quantum Mechanics and Overvoltage. R. W. Gurney. *Phys. Zeits. d. Sowjetunion*, 4. 2. *pp*. 360–363; *Disc*. 364, 1933. *In English*.—A discussion in terms of wave mechanics is given of the movement of electrons across the double layer at the electrode. It is shown that the ion may be discharged before it makes contact with the metal surface. When a positive ion approaches an electrode the electron wave may set up a large amplitude within the ion, and this represents the probability of capture of an electron before contact is made with the surface. Although quantitative treatment is as yet impossible, an approximate treatment, in which adsorption forces are neglected, yields a variation of the overvoltage with current density and temperature which is in agreement with experimental data. In the *Discussion*, **A. N. Frumkin** considers that the assumption that an uncharged metal surface in a electrolyte carries a layer of ions of both signs is not in accordance with experimental results, at least in the case of mercury, and questions whether it is permissible to neglect the movement of the discharged hydrogen atoms through the metal surface, since the adsorption potential of hydrogen on a metal surface may assume very high values. H. F. G.

5432. Electrolytic Cleaning of Metals. B. Kabanow. *Kolloid Zeits*. 65. *pp*. 101–105, *Oct*., 1933.—The electrolytic cleaning of greasy surfaces of iron, platinum and mercury was watched with the aid of a low power microscope. The dependence of wetting on polarisation of the metal surface is the basis of electrolytic cleaning, although other factors are of importance. Electrolytic cleaning, in which bubbles remove organic substances from the surface of the solid, can be regarded as the inverse of the flotation process in which the organic substance is used to fix the bubbles at the solid surface. The state of the solution affects the rate of cleaning. P. H. B.

See also Abstracts 5099, 5100, 5179, 5451.

ELECTRONS AND PROTONS.

5433. Distribution of Energies of Electrons in Gases. J. S. Townsend. *Phil. Mag*. 16. *pp*. 729–744, *Oct*., 1933.—The present paper is in answer to a recent publication by Didlaukis [see Abstract 3803 (1933)] wherein conclusions are arrived at in agreement with Franck and Hertz, *viz.*, that in the steady motion attained by electrons in a gas under the action of an electric force, the distribution of the energies of the electrons is very narrow. It is now shown that there is a wide distribution of such energies about the mean energy $\overline{E}$, and that there are wide variations in the velocities of the electrons in the direction of the electric force Z, also that the velocity W_1 of those electrons which have the energy of agitation $\overline{E}$ is less than $\overline{W}$. A more accurate formula for the velocity W_1 of a group of electrons all with the same velocity of agitation $\overline{U}$ is $2Zel/3m\overline{U}$ where l is the mean free path and e the atomic charge. H. H. Ho.

5434. Scattering of Slow Electrons by Single Crystals of Graphite. W. E. Laschkarew, E. W. Bärengarten and G. A. Kuzmin. *Zeits. f. Physik*, 85. 9. 10. *pp.* 631–646, *Sept.* 30, 1933.—By using the method involving a constant glancing angle the authors determine the scattering of slow electrons by Ceylon graphite for the angles, 55°, 65°, 75°. In the range from 6 volts to 150 volts they find seven maxima, of which three are to be interpreted as being forbidden (so-called half-number maxima). The results may be best accounted for by ascribing to the internal potential of graphite a constant value of about 20 volts. H. L. B.

5435. Scattering of Electrons by Nitrogen Molecules. H. S. W. Massey and E. C. Bullard. *Cambridge Phil. Soc., Proc.* 29. *pp.* 511–521, *Oct.* 30, 1933.—This paper gives experimental results for the scattering of 4 and 2 volt electrons in nitrogen, which are compared with Stier's theoretical curves [see Abstract 4562 (1932)]. An approximate theory of the scattering of electrons in nitrogen is given which is applicable when the wave length of the electron is small compared to the internuclear distance. The results are compared with experiment. AUTHOR.

5436. Scattering of Electrons by Metal Vapours. Part II. Zinc. E. C. Childs and H. S. W. Massey. *Roy. Soc., Proc.* 142. *pp.* 509–518, *Nov.* 1, 1933.—Measurements of the angular distributions of 4, 8, 13, 18, 23, 28, 38, 48, 58, 78, 118 and 143 volt electrons scattered elastically in zinc vapour are described. The resulting curves are compared with theoretical curves calculated by the use of a modified Fermi-Thomas field for zinc and Faxèn and Holtsmark's theory of scattering, good agreement being obtained. The relation of the scattering curves observed for zinc to those observed for cadmium and mercury is also discussed. [For Part I see Abstract 4256 (1933).] AUTHORS.

5437. Inelastic Scattering of Slow Electrons in Gases. Part IV. F. H. Nicoll and C. B. O. Mohr. *Roy. Soc., Proc.* 142. *pp.* 647–658, *Nov.* 1, 1933.—The investigations on the angular distribution of inelastically scattered electrons, described in a previous paper [see Abstract 5053 (1932)], have been extended to other gases. The voltages used extended from a few volts above the excitation potential upwards, measurements being made in methane, nitrogen, neon, and mercury vapour over the angular range 10°–155°. The inelastic scattering observed at small angles is discussed in relation to Born's theory, while the gradual disappearance of the diffraction effects at large angles at the lower voltages is investigated and discussed. AUTHORS.

5438. Diffraction of Fast Electrons. M. Kosman and A. Alichanian. *Phys. Zeits. d. Sowjetunion*, 4. 3. *pp.* 551–556, 1933. *In English.*—High tension was obtained by the use of Marx's impulse generator. The p.d. was then applied to a cold kathode discharge tube. In such a way electrons of very high velocities were produced. The diffraction of these electrons was studied and the corresponding de Broglie wavelength, as determined from the diffraction pattern, was found to be 0·0136 Å. The calculated energy of the electrons in electron-volts was equal to 530 kV. AUTHORS.

5439. Position of the Hydrogen Ions in the NH_4Cl Crystal Determined by Electron Diffraction. W. E. Laschkarew and I. D. Usyskin. *Zeits. f. Physik*, 85. 9–10. *pp.* 618–630, *Sept.* 30, 1933.—From measurements of the intensities of the Debye lines obtained by electron diffraction at an NH_4Cl crystal, it was found that the distance of the protons from the N nuclei was $0 \cdot 95 \pm 0 \cdot 07$ Å. The same distance was determined from X-ray data by calculation of the position of minimum potential energy of the protons, the value being $0 \cdot 97 \pm 0 \cdot 05$ Å. F. C. C.

5440. Electron Interference at Mechanically Worked Surfaces. H. Raether. *Zeits. f. Physik*, 86. 1–2. *pp.* 82–104, *Oct.* 17, 1933.—By means of electron interference a study is made of the changes caused by mechanical working in polycrystalline metal surfaces and in single crystal faces of non-metals. Scratched and roughly ground metal surfaces give weak Debye-Scherrer rings of the metal, presumably due to sharp crystalline points. Finer grinding causes the rings to increase in intensity and broaden somewhat. Surfaces given a fine finish by polishing, pressing or hammering show two broad rings, the lattice constant corresponding to which is approximately the same for all the metals investigated. The suggestion is made that the effective distance is here the mean distance between neighbouring atoms in a surface layer of "monatomic liquid metal" produced by the working. Of the non-metals after grinding FeS_2 and graphite give patterns corresponding to relatively large crystal fragments, as opposed to NaCl, CaF_2, etc., which give powder diagrams due to powder on the surface. At certain points on polished CaF_2 and $CaCO_3$ surfaces single crystal reflections are observed. L. A. W.

5441. Electron-Diffraction Investigation of the Structure of Molecules of Methyl Azide and Carbon Suboxide. L. O. Brockway and L. Pauling. *Nat. Acad. Sci., Proc.* 19. *pp.* 860–867, *Sept.*, 1933.—The method previously described [see Abstract 2108 (1933)] has been used. In the case of methyl azide two distinct structural formulæ have been hitherto proposed, *viz.*, one in which the nitrogen atoms form a three-membered ring, and in the other an open chain. Previous methods of investigation have not led to a decision, the electric moment measurements, for example, being compatible with either structure, but the present data show the azide group to be linear with a bond angle of 135° ± 15°. Both a ring and a chain structure have been proposed also for carbon suboxide, but the latter now proves to be correct. The interatomic distances are C to O = $1 \cdot 20 \pm 0 \cdot 02$ Å, and C to C = $1 \cdot 30 \pm 0 \cdot 02$ Å, which are just midway between the double-bond and triple-bond values suggesting the formula, $O = C = C = C = O$. H. H. Ho.

5442. Electron-Diffraction Investigation of the Molecular Structure of Cyanogen and Diacetylene, with a Note on Chlorine Dioxide. L. O. Brockway. *Nat. Acad. Sci., Proc.* 19. *pp.* 868–874, *Sept.*, 1933.—The structures of cyanogen and diacetylene have been previously investigated by the electron-diffraction method by Wierl [see Abstract 3904 (1932)], who reported non-linear models, with 150° bond angles for both molecules. This conclusion, which is incompatible with all other evidence for the angle between a triple and a single bond on the same carbon atom, has led to the present reinvestigation. Wierl's conclusions are now found to be erroneous, and the most probable values for the atomic distances, *viz.*

$$\text{C–N} = 1\cdot16 \pm 0\cdot02 \text{ Å and C–C} = 1\cdot43 \pm 0\cdot03 \text{ Å},$$

show that the single-bond models are somewhat more important than the double-bond models in the resonating structure which represents the structure of cyanogen. For diacetylene the most probable values are C–C at end = 1·21 ± 0·02 Å and C–C in centre = 1·43 ± 0·03 Å, the single-bond model making a greater contribution to the final structure than that of the models containing only six bonding electron pairs. For chlorine dioxide the most probable value for Cl–O is 1·53 ± 0·03 Å, which substantiates the type of resonance represented by the three-electron bond. The separation in the combined bond is nearer to that of the double than of the single bond. H. H. Ho.

5443. Electron Diffraction by Hydrocarbons. H. R. Nelson. *Phys. Rev.* 44. *pp.* 717–719, *Nov.* 1, 1933.—Thin films of vaseline, paraffin, and tap grease were prepared (1) by evaporation from a heated filament on to a metal surface, (2) by allowing an ether solution to evaporate from a water or metal surface leaving the hydrocarbon film behind and (3) by smearing the greases on metal surfaces. When 25 to 50 kV electrons were reflected at grazing incidence from these films the diffraction patterns consisted of rows of spots similar to an X-ray single crystal rotation picture. The resolving power of all but the smeared films is much better than has been reported previously. Observed reflections are in good agreement with the structure of normal hydrocarbon crystals found by Müller. The patterns indicate that the films are largely, if not completely, crystalline, with the long axes of individual crystals perpendicular to the plane of the film. AUTHOR.

5444. Structure of Thin Celluloid Films. Part I. E. T. Jones. *Phil. Mag.* 16. *pp.* 793–808, *Oct.*, 1933.—In a continuation of the author's earlier work [see Abstract 954 (1932)] an electron diffraction photograph consisting of two double patterns of spots was obtained with a thin film of celluloid. The more intense or principal double pattern is supposed to be produced by diffraction of the primary beam falling on two adjacent portions of the film in which the lattices are identical, but inclined to each other. Above or below these is a thinner layer of the same lattice, again differently orientated, which produces part of the secondary double pattern. It is also assumed that the curvature of the film is sufficient to allow pencils already reflected by certain planes in one layer to be again reflected by planes not parallel to the first in a subsequent layer of the film, so that part of both principal and secondary patterns is produced by twice reflected pencils. It is suggested that the formation of the film by the evaporation of a solution is responsible for the formation of the layers. A simple possible form of lattice is proposed, its spacing deduced, and the nature of the lattice points discussed. J. E. R. C.

5445. Inner Potential of Semi-Conductors. K. R. Dixit. *Phil. Mag.* 16. *pp.* 980–994, *Nov.*, 1933.—By using fast electrons and the method of visual measurements the inner potentials of ZnS, PbS, FeS_2, and Fe_2O_3 have been determined, the substances used being all natural crystals.

The values found are $-4\cdot8$, $+12\cdot5$, $+5\cdot1$, and $+\cdot126$ volts for ZnS. PbS, FeS_2, and Fe_2O_3 respectively. These are checked by Kikuchi line measurements. A method called the motion of the zone axis method is developed to check the orders assigned. Theoretical estimations of Φ have been made by using a modified form of Bethe's formula. Presence of surface effect has been observed, and the positions of the surface lines correspond to those to be expected from the crystal symmetry. AUTHOR.

5446. Polarisation of Electrons by Reflection. T. Förster. *Zeits. f. Physik,* 85. 7–8. *pp.* 514–529, *Sept.* 23, 1933.—By generalising a result given by Frenkel the author shows that, according to Dirac's theory, a plane " potential barrier " may act neither as a polariser nor as analyser in the optical sense towards the reflected or transmitted part of a ray of spinning electrons. An unpolarised incident ray does not become polarised by transmission or reflection, and for a polarised ray the reflection and the transmission coefficients are independent of the intensity and direction of polarisation. H. L. B.

See also Abstracts 5106, 5251, 5252, 5253, 5462.

ELECTROSTATICS.

5447. Influence of Contact Potential on Electrometer Measurements. E. Rumpf. *Phys. Zeits.* 34. *pp.* 735–742, *Oct.* 1, 1933.—A new arrangement is described to balance out the edge potentials in an electrometer. It is found that in very sensitive electrometers, the contact potential introduces errors in the measurements when the applied potentials do not greatly exceed the former. It is also shown that variable condensers lead to errors and are only advantageous when contact p.d. is required. No variation of contact potential is present in an electrometer with a platinum needle. The symmetrical position of the needle is studied, but it is probable that this is not the most practical arrangement. H. M. B.

5448. Electrostatic Machine. P. Jolivet. *Comptes Rendus,* 197. *pp.* 744–746, *Oct.* 9, 1933.—The construction of a simple electrostatic machine, excited by residual charges of either sign and capable of yielding 100,000 volts, is described. [See Abstract 341 (1930).] H. J. H. S.

5449. Gold-Leaf Electroscope. J. Back. *Phil. Mag.* 16. *pp.* 775–778, *Oct.,* 1933.—A phosphor-bronze spiral strip is substituted for the gold-leaf in the Wilson type of electroscope, as it is found much easier to mount and can be more easily detached without fracture from the plate if it should " fly " to it. Results show that although less sensitive than a gold leaf, it has, for varying plate potential, a much more uniform sensitivity, which bears a linear relation to the higher leaf potentials. H. M. B.

See also Abstract 5489.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

5450. Hall Effect and Internal Photoelectric Effect in Cuprous Oxide. I. Kikoin and M. Noskov. *Phys. Zeits. d. Sowjetunion,* 4. 3. *pp.* 531–550, 1933. *In English.*—The conductivity and the Hall effect in Cu_2O were measured at room-temperature as well as at the temperature of liquid air during illumination. It was shown that the internal photoelectric effect really exists in Cu_2O. The spectral distribution of the photocurrent was measured. From the values of the Hall-constant and the conductivity the number of photoelectrons, the mobility and the free path of the electron were calculated. The values of the mobility, as well as the free path obtained for Cu_2O coincide with those usually obtained for normal metals. AUTHORS.

5451. Hall Effect and Resistance of Hydrogen-Charged Palladium-Silver and Palladium-Gold Alloys. J. Wortmann. *Ann. d. Physik*, 18. 3. *pp.* 233–250, *Oct.*, 1933.—Investigation was made to test whether the parallelism observed by Schniedermann [see Abstract 4566 (1932)] in the effect of absorbed H on the photoelectric and thermoelectric effects in Pd and Pd-Ag and Pd-Au alloys extends also to the Hall effect. It was found that: (1) the Hall effect of the uncharged Pd-Ag alloys proceeds exactly parallel to the photoelectric and thermoelectric effect. The maximum lies in all three cases at 40 % Ag; (2) this parallelism does not exist with the Pd-Au alloys. The photoelectricity and the thermo-e.m.f. have their maximum at 40 % Au, the Hall effect at 65 % Au; (3) absorbed H raises the photoelectric and thermoelectric effect, but lowers the Hall effect; (4) on charging of the Pd-Ag alloys the Hall effect strongly changes, attains a small secondary maximum at 20 % Ag, then decreases and has its maximum at 60 % Ag; (5) the Hall curve of the charged Pd-Au alloys resembles that of the uncharged. Both have a maximum at 65 % Au. A parallelism with the photo- and thermo-effect does not here exist; (6) with the Pd-Au alloys absorbed H lowers the conductivity up to a content of 30 % Au, raises it between 30–80 %, and at yet higher gold content it is without influence; (7) estimation by Sommerfeld's electron theory leads with charged and uncharged Pd to a contradiction with experiment. With the alloys this is not the case.
J. J. S.

5452. Magnetic Field in the Region of Supraconductivity. M. v. Laue and F. Möglich. *Preuss. Akad. Wiss. Berlin, Ber.* 16. *pp.* 544–565, 1933.—The subject is dealt with in a threefold manner according to the methods of treatment by previous authors. The treatise is mathematical throughout. In Part I the authors treat of the case of a ring in a supraconducting current path, according to the manner of von Lippmann deduced from the basis of the Maxwell theory. They show that at the edge or limits of a supraconductor, where the limits exist in a field free space the normal component of a magnetic field remains nil. Secondly, the number of lines of force which cross the surface of a ring-shaped supraconductor is also zero. The paper is entirely theoretical.
S. G. B.

MAGNETISM AND ELECTROMAGNETISM.

5453. Law of Discontinuous Distribution of Curie Points. Part III. Applications. R. Forrer. *J. de Physique et le Radium*, 4. *pp.* 427–439, *Aug.*, 1933.—The law stated in a previous paper [see Abstract 3225 (1933)] is applied to a number of ferromagnetic bodies to determine their electronic lattices. It is also applied to alloys of the type of β-brass which only indicate an electronic lattice by some anomaly of temperature. The diamagnetism of these alloys demonstrates that the lattice of orientation can exist although the constituent atoms possess no magnetic moment. The applications are not limited to ferromagnetism.
G. E. A.

5454. Theory of Ferromagnetic Powders and the Magnetic Susceptibility of Rocks. G. Grenet. *Comptes Rendus,* 197. *pp.* 746–748, *Oct.* 9, 1933.—The mean susceptibility and magnetisation of a substance which is composed of a ferromagnetic material distributed in a non-magnetic matrix has been calculated and the validity of the formulæ derived has been discussed for various concentrations of the ferromagnetic body. H. J. H. S.

5455. Susceptibility of MnO as a Function of the Temperature. R. W. Tyler. *Phys. Rev.* 44. *pp.* 776–777, *Nov.* 1, 1933.—There is a sharp discontinuity in the susceptibility-temperature curve of manganous oxide at the same point, $t = -156°$ C, as that in the specific heat temperature curve and a second one at a lower temperature, − 188° C. The mass susceptibility at 26° C was found to be $\chi = 68 \cdot 6 \times 10^{-6}$ c.g.s. units. At − 38·4° C, $\chi = 73 \cdot 6° \times 10^{-6}$. At − 154·7° C, $\chi = 85 \cdot 8 \times 10^{-6}$. At − 188° C, $\chi = 78 \cdot 1 \times 10^{-6}$. At − 202° C, $\chi = 91 \cdot 4$. The susceptibility temperature curve follows Weiss' modification of Curie's law down to $t = -156°$ C. The constants of this law were found to be $C = 0 \cdot 0575$ and $\theta = -548°$ K. The number of Bohr magnetons in the compound calculated from experimental data is 5·7. AUTHOR.

5456. Influence of Temperature on the Diamagnetism of Liquids. M. A. Azim, S. S. Bhatnagar and R. N. Mathur. *Phil. Mag.* 16. *pp.* 580–593, *Sept.,* 1933.—Experimental determinations of the variation of diamagnetism with temperature show clearly that the liquids examined by the authors may, in general, be divided into three types: (1) those in which the effect of temperature is practically negligible (cyclohexane and carbon tetrachloride); (2) those in which there is a definite increase in the value of the susceptibility with temperature (water, isobutyl alcohol, butyl alcohol, propyl alcohol and isopropyl alcohol); (3) those in which there is a decrease in susceptibility; these constitute the largest number in the present investigation (nitrobenzene, benzonitrile, ethyl-benzene, pseudo-cumene, mesitylene, toluene, *m*-xylene, aniline, *o*-nitro-toluene, iodo-benzene, bromo-benzene). Substances in class (1) are characterised by the non-polar and symmetrical nature of their molecular arrangement. Substances in class (2) are all noted for their polarisability and association. Substances in class (3) are almost all aromatic compounds. H. L. B.

5457. Susceptibility of Electrolytically-Charged Palladium-Hydrogen Alloys. B. Svensson. *Ann. d. Physik,* 18. 3. *pp.* 299–304, *Oct.,* 1933.—A short note on the relationship of the concentration and composition of electrolytically charged PdH alloys to their magnetic susceptibility. Vogt has shown considerable differences between PdAu, PdCu and PdAg alloys containing from 0 to 60 % of Pd, and those of PdH. He attributed these differences to their lattice structure. The present work shows that for certain proportions of admixture no such differences occur and curves of the same type are given by both series of alloys. S. G. B.

5458. Susceptibility of Paramagnetic Solutions. G. Foëx. *Comptes Rendus,* 197. *pp.* 749–751, *Oct.* 9, 1933.—The question is discussed whether, when a solution follows Weiss' law: $\chi(\tau - \theta) = C$, the moment of the ion should be calculated using C or the product $\chi\tau$ as the Curie constant, and arguments are given in favour of the former view. [See also Abstract 3830 (1933).] G. E. A.

5459. Susceptibility of Oxygen Gas. E. C. Wiersma and C. J. Gorter. *K. Onnes Lab., Leiden, Comm. No.* 217–228. *Suppt. No.* 73. *pp.* 35–40, 1933. *In English.*—The consideration of recent measurements [see Abstract 3225 (1931)] of the susceptibility of gaseous oxygen suggests the existence of a paramagnetic term, independent of the temperature in addition to the well-known paramagnetism, due to the presence of 2 electronic spins per molecule. The dependence of the susceptibility on the density suggests polymerisation to O_4, in accordance with an assumption previously made by Lewis. Further evidence for this association, from other physical properties of oxygen, is discussed. AUTHORS.

5460. Susceptibility of Argon. W. Gerlach. *Zeits. f. Physik*, 85. 9–10. *pp.* 545–547, *Sept.* 30, 1933.—Specially purified A, containing only about 0·1 % Ne as impurity, has been examined at temperatures between 17° and 430° C and at different field strengths. The value of the specific susceptibility is independent of both temperature and field strength. From the values obtained for the specific susceptibility under these different conditions the molecular susceptibility is given as $-19\cdot72 \times 10^{-6}$. W. R. A.

5461. Paramagnetic Properties of Crystals of the Rare Earths. Part II. H. A. Kramers. *K. Akad. Amsterdam. Proc.* 36. 1. *pp.* 17–26, 1933. *In French.*—A continuation of previous work [see Abstract 1849 (1933)] in which the theory deals with the paramagnetism of a crystalline powder such as CeF_3, and a value for the susceptibility is found. In the second part an expression is obtained for the paramagnetic rotation in a crystal, such as tysonite, in a magnetic field parallel to the axis. G. E. A.

5462. Models of the Electric Field and of the Photon. J. J. Thomson. *Phil. Mag.* 16. *pp.* 809–845, *Oct.*, 1933.—The ether is supposed to consist of moving granules of a size infinitesimal compared with that of an electron. The number of granules associated with an electron or proton is proportional to its mass or energy. Tubes of electric force are represented by vortex filaments in the ether. In moving, a tube of force sweeps up granules, thus leading to the increase of mass of an electron in motion. The model leads to Maxwell's equations of the electric field. The photon is supposed to be a closed vortex filament in the ether. A moving electron will be associated with a system of waves, whose wavelength can be deduced from the theory. G. C. McV.

5463. Attraction between Coils in the Rayleigh Current Balance. C. Snow. *Bureau of Standards, J. of Research*, 11. *pp.* 681–689, *Nov.*, 1933.—A formula is derived for the force between two parallel coaxial coils whose winding channels have rectangular cross sections. The expression for the maximum force also is obtained. The linear dimensions of the cross section of the windings are all small compared with the mean radii of the coils and sixth-order terms in these ratios are neglected. The principal term in the force corresponds to two linear circular currents in the mean positions of the coils. The remaining terms take account of (*a*) the finite cross section of the winding channels, (*b*) the discrete nature of the windings (round insulated wires) with waste space between them, and (*c*) the nonuniformity of current over the section of the wire. The effects (*b*) and (*c*) are eliminated when the ratio of the mean radii of the coils is determined electrically. AUTHOR.

5464. Induction Coil Discharges. W. McFarlane. *Phil. Mag.* 16. *pp.* 865–896, *Nov.*, 1933.—Recent work on the nature of the discharge produced by an induction coil across an air-gap has been described by Finch and Sutton [see Abstract 2628 (1933)]. In the present work a much larger coil is described and many new features appear. The coil used was capable of giving a 12 inch spark and the current and potential variations were measured, via resistances, by means of a kathode-ray oscillograph. When the interrupted primary current is much larger than the minimum necessary to produce a discharge, the discharge consists of two distinct parts (*a*) the capacity component, a single bright spark due to the discharge of the static electricity from the capacity of the coil, and (*b*) the more prolonged inductance component, which is shown to have the form of a glow discharge. Curves are given showing the current and potential variations. When the current broken in the primary is large enough, a true arc discharge is formed immediately after the initial spark. The current, however, diminishes with time and reaches a value which is unable to sustain the arc, the discharge then reverting to the more usual glow discharge. A detailed theory of the inductance component of the discharge is evolved, and an expression obtained for the current flowing in the discharge. The experimental results are found to fit the theory if the experimental value of the initial amplitude is used. The time of duration of the discharge is calculated and found to be in agreement with experiment. Observations were made on the variation of the discharge as the primary current was increased from the minimum necessary to produce a spark. The discharges show a gradual change as the current increases, from a single spark up to the spark-arc-glow form described. A number of plates showing oscillograph traces are included. J. E. R.

5465. Mechanostriction and ΔE Effect. N. Akulov and E. Kondorsky. *Zeits. f. Physik*, 85. 9–10. *pp.* 661–671, *Sept.* 30, 1933.—The distribution function for elastically strained single crystals possessing three or four axes of easy magnetisation is derived and applied to the calculation of the various magnetomechanical properties of single crystals of nickel and iron, as well as polycrystals. The general formulæ for calculating the mechanostriction and the ΔE effect are deduced, and a closer connection between the two effects is found. The theory agrees with the results of experiment. [See also Abstract 779 (1933).] G. E. A.

See also Abstract 5140.

MEDICAL RADIOLOGY AND ELECTROLOGY.

5466. Kathode-Ray Oscillogram of Action Potential of Nerve. S. Watanabe and K. Sasagawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 435. *pp.* 139–148, *Aug.*, 1933. *In English.*—The nerve in question (sciatic nerve of a bull frog) was excited by an induction coil, the response being measured by connecting two leads to the input terminals of a three-stage resistance-coupled amplifier, in the output of which is connected a kathode-ray oscillograph of the hot kathode type. A suitable frequency scale is provided by a tuning fork of frequency 1034 ∼. The experiments, which were made chiefly to test the suitability of the apparatus, showed that consistent and reproducible results could be obtained. G. E. B.

5467. Effects of A.C. upon Cutaneous Sensory Thresholds. I. M. Thompson. *Science*, 78. *pp*. 268–269, *Sept*. 22, 1933.—Reference is made to results of previous experiments [see Abstract 2067 (1933)] in which an alternator method was utilised to map areas of nervous supply. In these experiments, whilst the effect of the current applied was to modify the sensation of light touch and allow the nerve distribution to be determined, painful and thermic sensation was not affected to the same extent. The threshold values of these sensations are, however, raised by the application of the a.c., and curves to illustrate the variations for pain, heat, cold, pressure and touch, in respect to the superficial branch of the left radial nerve, are shown. Pressure was most affected, touch and pain to a much less extent, whereas the thresholds for heat and cold were very erratically and little modified. Reference is made to the fact that this "benumbing" effect of electric current has been long known and was applied, to induce local anæsthesia, in 1858. B. J. L.

5468. Pathology of Death by Electrocution. A. Zimmern. *J. de Radiologie et d'Électrologie*, 17. *pp*. 589–592, *Oct*., 1933.—An historical review is given in respect to development of theories regarding the actual pathological cause of death by electrocution. The consensus of opinion is towards a dual origin, namely, interference with the heart pulsation and paralysis of respiration. The success of artificial respiration, in cases of low-tension electrical shock, is in favour of respiration paralysis, rather than cardiac interference, as the essential cause of death. Simonin has suggested that respiration ceases owing to tetany of the respiratory muscles. Zadek and Lichtenstein have reported a case of a patient whom after severe shock, complained of violent thoracic pain and expectoration of blood, probably due to post-effects of the alveolar tissues. The nervous and mental reactions are briefly discussed, following electric shock and hæmorrhage of the brain results. The author finally draws attention to the fact that the definite cause of death may possibly be multiple, but, probably, cessation of respiration is largely responsible. B. J. L.

5469. Use of H.F. Electric Fields to Raise Body Temperature. W. E. Curtis and S. F. Evans. *Univ. Durham Phil. Soc., Proc*. 9. *pp*. 61–72, *June*, 1933.—The possibilities and advantages for medical purposes, of the use of h.f. electrical oscillations, in order to raise internal body temperatures, are discussed. A h.f. apparatus is described; it utilises two valves in "push-pull," dissipating 2kW, and produces the oscillating potentials (frequency approx. 10^7 cycles/sec.) between two large plates. Details are given of a suitably protected box to contain the patient. Observations were made on the temperature rise (oral and rectal) produced by the oscillations in 8 healthy subjects. The rate of rise of temperature varied from 1·7 to 4·7° F. per hour. Control experiments in which the subject was immersed in heated air without the h.f. oscillations are described. J. E. R.

5470. Production and Use of H.F. Currents in Medicine. Réchou, Halphen and Auclair. *J. de Radiologie et d'Électrologie*, 17. *pp*. 481–506, *Sept*., 1933.—A general historical review of the development of short-wave medical diathermy is given, discussing electromagnetic oscillations generally, particularly with respect to the infra-red and short-wave wireless regions. The production of oscillations is then treated mathematically and diagrammatically, on the basis of the general principles of radio-telegraphy. The physical and biological properties of short-wave oscillations are then discussed, again partly on a mathematical basis. The various diseases in which this short-wave diathermy energy can be applied are then reviewed. The paper is followed by a most extensive Bibliography and, although no new facts are developed, the paper comprises a very thorough review of the present situation of short-wave medical diathermy. B. J. L.

5471. Measurement of H.F. Current in Medical Applications. A. Laquerrière and L. Pariseau. *J. de Radiologie et d'Électrologie*, 17. *pp.* 581–585, *Oct.*, 1933.—Whereas in radio-telegraphy and -telephony it is possible to carry out exact measurements of current, frequency, current form, etc., in medical applications of h.f. current, similar accuracy is not obtainable, since large and complicated instruments cannot be applied and because variations occur in the contacts made to the patient. In surgical applications of h.f. diathermic current, the surgeon increases the current strength until he obtains suitable sectioning of the tissues, but has no actual knowledge of the voltage or intensity. It has been suggested, in France, that the older damped diathermy apparatus gave better results than the more modern undamped apparatus, possibly due to faradic and other effects. In medical apparatus the form of the current may be roughly ascertained from the type of apparatus, but the oscillographic representation can hardly be obtained practically, whilst frequency is more easily measured between 500,000 and 2,000,000. Potential is not of utmost importance, and the energy can be obtained by a watt-meter inserted in the primary circuit, or by a thermic milliammeter, although this gives no information of the wattless current in respect to the patient. Indirect methods of measurement are therefore utilised, particularly measurement of the tissue temperature, although thermoelectric phenomena are not applicable to this purpose. To determine the partition of the heat effect *via* the tissues, one of the authors has utilised change of colour of the tetraiodide of mercury and gold. Prior examination of the patient is of utmost importance to determine suitability of the treatment. Purely physical methods of measurement are generally of less importance than clinical observations. B. J. L.

5472. D'Arsonval's Contributions to L.T. Electrotherapy. G. Bourguignon. *J. de Radiologie et d'Électrologie*, 17. *pp.* 593–600, *Oct.*, 1933.—A review of the past inventions, etc., of d'Arsonval on the occasion of his jubilee. The instruments briefly discussed are, thermoelectric needles and measuring instruments, the Deprez-d'Arsonval galvanometer, a chronometer for measurement of the velocity of nervous impulses, non-polarised electrodes for electrical treatment, condensers for sinusoidal a.c. applications, measurements in electro-physiology in respect to muscle and nerve excitation, and application of the condenser discharge to this object, electrotherapeutic applications generally. B. J. L.

5473. Physical Foundations of Chest Roentgenography. Parts I and II. R. B. Wilsey. *Am. J. of Roentgenology and Radium Therapy*, 30. *pp.* 234–241, *Aug., and pp.* 388–400, *Sept.*, 1933.—In the first part of this paper the projection of the shadow is discussed, from the aspects of optics, with respect to contrast sharpness and distortion. Decrease in distortion with increase of target-film distance, becomes less, in respect to the cost of the appertaining apparatus, as the energy of the exposure required varies with the inverse square law. Most of the distortion occurs within a target-film distance of 4 ft. and, beyond this, the resulting decrease varies very slowly, so that, at 6 ft. there is very slight advantage over a 4 ft. distance. To minimise distortion in stereoscopic procedures a method is described for long target-film distances in which the stereoscopic shadows are viewed at a short distance (25–30 ins.). To secure best definition the X-ray tube should be operated at, or near, its maximum load capacity and, under this condition, variation of target-film distance has practically no effect upon sharpness, provided the angle of the target face is fixed. In Part II the sharpness of outline of X-ray shadows of the lung tissues is stated to be due to two factors, namely, movement of the tissues caused by the heart beat and the size of the focal spot of the X-ray tube. Mutual adjustment of these two factors, to produce the maximum sharpness, may be worked out by the analytical method of Bouwers. Application of this method to thoracic radiography indicate that the best exposure time for maximum definition is in the neighbourhood of 1/20th sec. It is also considered that further improvement, in respect to sharpness, is in the use of the rotating line-focus X-ray tube, with synchronisation of the exposure with the phase of minimum lung movement, as proposed by McPhedran and Weyl. This procedure has the additional advantage of permitting a longer time of exposure, so decreasing the power required from the X-ray apparatus, as well as minimising the distortion which results in stereoscopic films, due to movement of the lung tissues between the stereoscopic exposures. B. J. L.

5474. Genealogy of X-Rays. O. Glasser. *Am. J. of Roentgenology and Radium Therapy,* 30. *pp.* 180–200, *Aug., and pp.* 349–367, *Sept.,* 1933.—A purely historical paper, giving in this respect, important information and many interesting reproductions of early investigators, their books, writings and apparatus. The paper covers the development of electricity up to the discovery of X-rays by Röntgen in 1895. Many of the earlier investigators, such as Gilbert, von Guericke, Boyle, Hauksbee and others, who developed electrical theory and accessory apparatus such as pumps, etc., permitting the production of vacua, are discussed and their work reviewed. B. J. L.

5475. Energy Considerations in High-Voltage Therapy. C. C. Lauritsen. *Am. J. of Roentgenology and Radium Therapy,* 30. *pp.* 380–387, *Sept.,* 1933.—The relationship between the Röntgen and actual energy per square cm. is discussed and plotted for a range of 100 to 2,200 kV. The number of R units necessary to produce an erythema is calculated on the basis of certain assumptions, which, whilst these cannot be theoretically justified, permit fair agreement with actual observations. To measure the attenuation, absorption in water is utilised and such absorption is discussed theoretically, particularly in respect to work by Klein and Nishina, the paper being largely mathematical and illustrated by graphs. As a practical medical result it is shown that, in X-ray therapy, the use of soft radiation results in destruction of normal tissue, with relatively little absorption in a deep-lying tumour, particularly if small ports of irradiation are used, so that, in low voltage work, large fields of irradiation have to be utilised. A further paper will appear discussing irradiation where the photoelectric absorption is not negligible as in the present range of voltages. B. J. L.

5476. Changes in Susceptibility of Drosophila Eggs to X-Rays. P. S. Henshaw and C. T. Henshaw. *Radiology*, 21. *pp.* 239–251, *Sept.*, 1933.—The lethal effect of X-rays upon the eggs of *Drosophila melanogaster* eggs has been utilised in respect to determination of X-ray dosage [see Abstract 2640 (1933)]. Various irregularities have been observed in the biological action and the present paper is the result of tests as to reliability, data being given in respect to culture of the flies, collection of their eggs and irradiation. The experiments have shown the effects vary considerably with the stage of development of the eggs. B. J. L.

5477. Determination of High Potentials and High Potential Wave Forms. P. Kirkpatrick. *Radiology*, 21. *pp.* 378–384, *Oct.*, 1933. —Advances in medical radiology necessitate the performance of more precise physical measurements, particularly in respect to the measurement of high potentials. For such measurement the author gives detail of an instrument which he believes to be novel. Between two terminals, across which the high tension potential is applied, a metal cylinder, split longitudinally, is placed and means are provided for its rotation. As the cylinder is rotated the resulting changes of charge upon its two halves, gives rise to a current which is caused to flow *via* an external circuit. As a result there is an a.c. in this circuit, which may be rectified and measured, preferably by a d'Arsonval galvanometer, or an ordinary microammeter. If the potentials to be measured are not constant, but periodically variable, the current to be measured varies with the phase relationships, between the revolution of the motor and the potential variations. If provision is made to vary this phase relationship, the instrument may be utilised to plot the actual wave form of the voltage. The apparatus is illustrated and the wave forms obtained, for direct excitation of an X-ray tube when placed directly across transformer terminals, or between two valves, or as operated by four-valve full-wave rectification, are shown and discussed. The instrument is portable, robust, easy to operate and, in its range, varies from a fraction of one volt, to the highest potential obtainable. It is accurate to a small fraction of 1 %, has a linear scale, and is at ground potential, drawing no current from the h.t. source. It is not yet manufactured commercially, but the author's details are stated to provide sufficient detail to permit manufacture. B. J. L.

5478. Depth Dose Calculations for Super-Voltage X-Rays. M. A. Tuve. *Radiology*, 21. *pp.* 289–295, *Sept.*, 1933.—It is assumed by many, not engaged in actual X-ray therapeutic treatment, that increase of X-ray tube voltage will result in increased penetration and increased depth dose applied to tumours. As a result, the tube voltage has been increased from 200 kV to 2,000 kV. The present paper is largely a discussion of curves of actual measurements and data obtained from a radium γ-ray apparatus. The depth dose of a 2,000 kV X-ray tube, heavily filtered by lead, is discussed. Owing to the proportional absorption it is possible that there is no extreme gain of depth dosage to be expected by use of very high voltage X-ray radiation. Biological effects may possibly differ in respect to the equivalent excitation voltage, but only careful and extended measurements with high voltage tubes can prove this. B. J. L.

5479. Evaluation of " Depth Doses " of γ- and X-Rays. W. J. Rees and L. H. Clark. *Brit. J. of Radiology*, 6. *pp.* 588–597, *Oct.*, 1933. —An attempt is made to obtain an empirical relation enabling one to calculate "depth doses" for penetrating radiations; *i.e.*, the amount of radiation, primary and secondary, which is observed at any depth in an irradiated medium. Using a large tank containing water as a phantom, and an aluminium electroscope as ionisation chamber, a series of curves are obtained showing the variation of dose with depth for γ-rays and 200 kV X-rays under a number of experimental conditions. The amount of primary radiation at any depth can be estimated from the inverse square law, together with the linear absorption coefficient of the radiation in water. An analysis of the measurements shows that when there is sufficient water beneath the measuring instrument the amount of the scattered radiation at a depth D is given by the product of the primary radiation there and a factor of the form $(B + AD)$. B is a constant giving the amount of backscatter from the water below the chamber. This factor is found by taking measurements of the increase in ionisation when the tank is filled up to the level of the ionisation chamber. A is a constant corresponding to the scattered radiation from the water above the chamber and is found by taking comparative measurements at an arbitrarily fixed depth. The empirical formula obtained for the ionisation at a depth D is: $I_D = I_0 e^{-\mu D}\left(\frac{F}{F + D}\right)^2 (1 + B + AD)$, where I_0 = ionisation at surface level without back-scatter, μ = coefficient of absorption of primary rays, F = focal skin distance. In general, this formula fits the experimental curves very closely, small discrepancies only being observed with X-rays when small field areas are used. J. E. R.

5480. Three Problems of γ-Ray Therapy. W. V. Mayneord. *Brit. J. of Radiology*, 6. *pp.* 598–614, *Oct.*, 1933.—The paper deals with the problems of (*a*) percentage depth dose in external γ-ray therapy, (*b*) the effect of filter on γ-ray quality, and (*c*) the measurement of γ-ray quantity in an ionisation unit. The results of measurements in a wax phantom, using a condenser dosemeter of the Sievert type, for a γ-ray source at radium skin distances from 5 to 75 cms., are described and discussed. It is pointed out that the values of D_{10} obtainable with γ-rays used at short distances from the skin, are small compared to those from high-voltage X-rays. At comparable skin distances, however, the γ-ray source gives values considerably in excess of those obtained with X-rays at 400 kV. [See Abstract 3656 (1933).] An attempt is made to predict the course of the absorption curves for the γ-rays from Ra (B + C) in Cu, Pb and Pt. The results are in good agreement with experimental work. They serve chiefly to indicate the advantages of the use of heavy element filters in external therapy. The last section collects evidence regarding the total ionisation produced by a given amount of Ra (B + C). The value of 8·9 r/mg. hr. at 1 c.m., obtained previously by the writer is in accord with recent determinations of Eve's number, as well as investigations by L. H. Gray of the total ionisation produced in a scattering medium by radium. All these results diverge greatly from the results of parallel plate chamber measurements by Failla and Henshaw, who obtained values of the ionisation 4·5 times smaller than the "air" wall chamber results. J. E. R.

5481. Recommendations of the Third International Congress of Radiology Relating to Protection from X-Rays and Radium. L. S. Taylor. *Radiology*, 21. *pp.* 212–216, *Sept.*, 1933.—The above recommendations are given in detail and briefly discussed, to the effect that actual sheet lead protection is not insisted upon, but "lead equivalent." It is commented that lighting and ventilation is generally poor in X-ray departments and there is a lack of personal protection, *i.e.*, aprons, etc. Since the Second International Congress an Advisory Committee in the U.S.A. have drawn up further recommendations. With the advent of self-protected X-ray tubes, h.t. cables, etc., many of the earlier problems of protection have been automatically solved. Further progress in protective measures may be expected at the coming fourth International Congress at Zurich in 1934. B. J. L.

5482. Whole Animal Exposures to Highly Filtered γ-Rays. W. G. Whitman. *Radiology,* 21. *pp.* 265–273, *Sept.*, 1933.—The development of high voltage X-ray tubes, operating at the order of 1,000,000 volts and giving radiation comparable to the γ-radiation of radium, has introduced new problems in respect to the protection of operators. A tube operating at 1,000,000 volts and 4 m. gives as much radiation as that obtained from 1,000 gm. of radium. Since 4 or 5 in. of lead are used to shield only 4 or 5 gm. of radium, the magnitude of the protection problem, when working with high voltage X-ray tubes, may be appreciated. In respect to this problem the author has carried out experiments upon 83 rats, subjected to highly filtered γ-rays of radium. Details of the methods of exposure are given and the paper is largely the discussion of graphs, so obtained, in respect to counts of the white cells of the blood. As a more reliable, quicker and more certain method for the detection of radiation, the use of dental X-ray photographic films is suggested. B. J. L.

See also Abstract 5349.

OSCILLATIONS, ELECTRIC.

See Abstract 5346.

PHOTOELECTRICITY.

5483. Analysis of the Secondary Radiation from Aluminium, Nickel, Silver and Gold at the Surfaces of Incidence and of Exit of X-Rays. H. Schenck. *Ann. d. Physik,* 17. 2. *pp.* 146–168, *May,* 1933.—The dependence of the emission of electrons at the surfaces of incidence and of exit of X-rays upon the thickness of the targets of Al, Ni, Ag and Au, and upon the hardness of the incident X-rays is investigated experimentally. The emission is analysed into (1) characteristic secondary radiation, (2) electron emission excited entirely by the primary radiation, and (3) electrons liberated by reabsorbed characteristic radiation. The latter contribution increases with thickness of the target, and for very thick targets can exceed the emission excited solely by the primary radiation. In no case was the emission of secondary scattered radiation observed ; such emission is extremely small compared with those observed. With decreasing atomic number the asymmetry of emissions in the forward and backward directions increases. J. S. G. T.

5484. Influence of the Adsorbed Gas Layer on Photoelectric Sensitivity. B. Abendroth. *Zeits. f. Physik,* 85. 7–8. *pp.* 530–544, *Sept.* 23, 1933.—It is shown that platinum which has become insensitive photoelectrically owing to prolonged heating becomes very active if water vapour or vapour of pyridine, propionic acid or benzol is deposited on the platinum in a thin (probably monomolecular) layer. If absorbed in greater quantity these vapours decrease the sensitivity. By heating up the platinum they may be driven off and this causes the photoelectric current to increase again until finally when all the layers have been removed it decreases practically to zero. The dipole moment has no essential influence on this behaviour. CdI_2 behaves like Pt. Hence an explanation that was given earlier by Werner for these phenomena must be regarded as untenable. H. L. B.

5485. Cuprous Oxide Photoelectric Cells. W. Bulian. *Phys. Zeits.* 34. *pp.* 745–756, *Oct.* 15, 1933.—An account is given of investigations of those properties of cuprous oxide photoelectric cells (*viz.*, spectral sensitivity, conditions for maximum response, variation with temperature, etc.) which are most important from a practical point of view in using the cells for measuring purposes. It is found that the wave-length of the selective maximum is independent of the nature of the metal of the sputtered electrode, but that there is a certain optimum film thickness for maximum response. In the case of cells sputtered with gold the direction of the photoelectric current depends upon the wave-length of the incident light. The thickness of the oxide layer giving maximum response for illumination with light of the visible region is found to be 0·1 mm. Measurements at temperatures between 10° C. and 85° C. show that the nature of the temperature variation of the photoelectric effect is different for different electrode metals. In the case of sputtered gold the direction of the current is reversed at about 47° C. By suitable choice of the electrode metal it is possible to make the behaviour of the cell independent of temperature over a wide range. L. A. W.

5486. Photoelectric Secondary Current. W. Lehfeldt. *Göttingen Nachrichten, Math.-Phys. Klasse, No.* 3. *pp.* 263–270, 1933.—New experimental observations, whose object is the investigation of the nature of the secondary currents in photo-conductive crystals, are described. In ZnS crystals it was found that the size of the photoelectric secondary currents was proportional to the number of excited " centres," as found by measurements on the phosphorescence of the crystal. The temperature variations of these two phenomena were also found to be similar. AgCl showed a marked secondary photoelectric current, which is interpreted as being due to two kinds of " centres " whose life-periods of excitation are widely different. Phosphorescence was observed only by the application of large electric fields. It is concluded that the secondary current is electronic in character, from consideration of the temperature effects, the absence of electrolytic effects, and the appearance of luminous current paths. The poor conductivity of the crystals, which would not be expected upon this hypothesis, is explained as being a result of the nature of the excitation of the " centres." D. H. F.

See also Abstracts 5231, 5450, 5489, 5490.

PIEZOELECTRICITY.

5487. Application of Methods of Geometrical Inversion to the Solution of Problems in Electrical Resonance. W. G. Cady. *Am. Acad., Proc.* 68. *pp.* 383–409, *Sept.*, 1933.—The method described was developed with particular reference to the piezoelectric resonator, but it is equally applicable to any type of a.c. network containing a sharply tuned resonating element. The distinguishing feature of the method lies in the use of a single circular locus for both admittances and impedances. The process of inversion, instead of requiring the construction of a new diagram, now demands only a change in the value of the unit vector. The solution of problems is thus greatly simplified and the effect of varying the frequency or any other parameter is easily followed. The frequency-calibration of the circular locus is described, and the properties of the quadrantal points and especially of the points of maximum and minimum admittance are discussed. The effects upon the performance of the circuit of the addition of fixed impedances in series or parallel with the resonant element are considered, and examples are given of the application of the method. A. W.

See also Abstract 5380.

THERMIONICS.

5488. Thermionic Effect and Laws. B. Rossi. *Alta Frequenza,* 2. *pp.* 327–345, *Aug.*, 1933.—The thermionic effect is the emission of electrons from a hot metal, and the electrons which emerge are those which come to the metal's surface with a sufficiently large normal component of kinetic energy. By considering the free electrons of a metal as a perfect gas, corresponding to Fermi's statistics, an equation is obtained in full accordance with the experimental results. The effect of the impurities on the surface is explained as a double electric layer, which aids or hinders the exit of the electrons depending on the sign of its polarisation. AUTHOR.

5489. Work Function and Photoelectric Properties of Metals. P. I. Lukirsky. *Phys. Zeits. d. Sowjetunion,* 4. 2. *pp.* 212–238, 1933.—On the occasion of a conference dealing with surface adsorption a general account and discussion is given of the relevant aspects of the investigations of the author and his co-workers upon (*a*) the contact potential of metals and (*b*) photoelectric properties. In connection with (*a*) reference is made to previously published work [see Abstract 177 (1932)] and also to some further similar results, obtained by Zarewa by the same method, upon layers of silver and magnesium deposited upon nickel by evaporation *in vacuo*. The section upon (*b*) is confined to a restatement and discussion of previously published work. [See Abstracts 220 and 2991 (1932).] L. A. W.

5490. Thermionic and Photoelectric Emission of Cæsium-Cæsium Oxide Kathodes as Influenced by Incorporation of Cæsium Atoms in the Dielectric. P. Görlich. *Zeits. f. Physik,* 85. 1–2. *pp.* 128–130, *Aug.* 29, 1933.—Further evidence is brought forward supporting the observation of de Boer and Teves [see Abstract 4295 (1933)] that incorporation of Cs atoms in the oxide layer gives increased emission. Another method for accomplishing the incorporation of Cs atoms in Cs_2O layers is here described, in which Cs atoms from a Cs-coated tungsten spiral heated to dull red are made to impinge on the Cs_2O-coated silver kathode by applying 100 volts between the anode spiral and the kathode. Photoelectric emission of two to three times that given by the original kathode is obtainable by this incorporation process. W. S. S.

5491. Surface Ionisation of Potassium on Molybdenum. R. C. Evans. *Cambridge Phil. Soc., Proc.* 29. *pp.* 522–527, *Oct.* 30, 1933.—Some experiments are described in which the efficiency of ionisation of potassium at a hot molybdenum surface was investigated. The degree of ionisation observed is consistent with the most recent measurements of the electron work function of molybdenum. AUTHOR.

THERMOELECTRICITY.

See Abstract 5154.